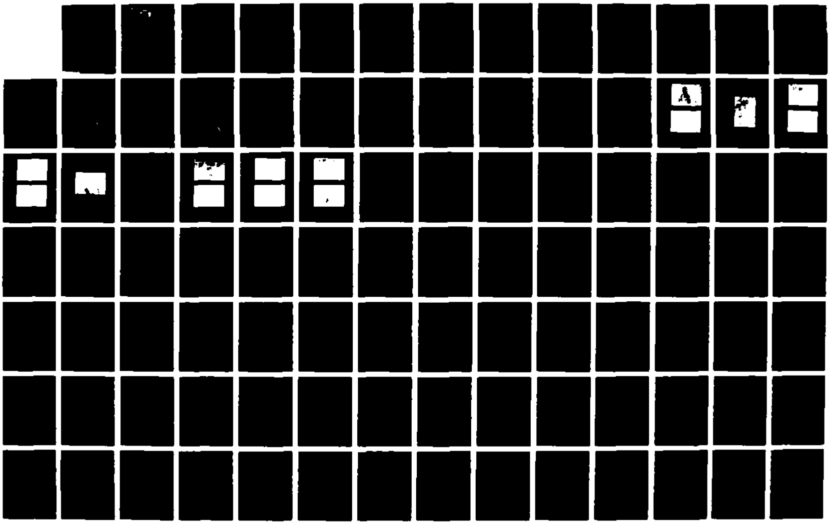
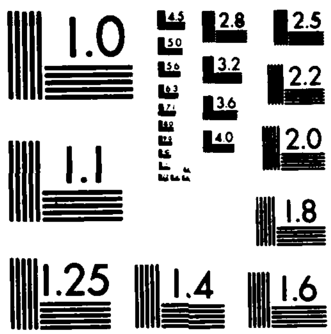
AD-A192 042 EVALUATING EVAPORATION WITH SATELLITE THERMAL DATA(U) 1/2
BRIGHAM YOUNG UNIV PROVO UT DEPT OF CIVIL ENGINEERING
A W MILLER ET AL. NOV 87 AFOSR-TR-88-0131 AFOSR-87-0177

UNCLASSIFIED F/G 8/8 NL





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SECURITY CLASSIFICATION OF THIS PAGE

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REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION: Unclassified

1b. RESTRICTIVE MARKINGS

3. DISTRIBUTION/AVAILABILITY OF REPORT: Approved for public release; distribution unlimited.

AD-A192 042

5. MONITORING ORGANIZATION REPORT NUMBER(S): AFOSR-TR- 88-0131

6a. NAME OF PERFORMING ORGANIZATION: Brigham Young University

6b. OFFICE SYMBOL (If applicable)

7a. NAME OF MONITORING ORGANIZATION: AFOSR/NC

6c. ADDRESS (City, State, and ZIP Code):
Department of Civil Engineering
Brigham Young University
Provo, UT 84602

7b. ADDRESS (City, State, and ZIP Code):
Bld 410
Bolling AFB, DC 20332-6448

8a. NAME OF FUNDING/SPONSORING ORGANIZATION: AFOSR

8b. OFFICE SYMBOL (If applicable): NC

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: AFOSR-87-0177

8c. ADDRESS (City, State, and ZIP Code):
Bld 410
Bolling AFB, DC 20332-6448

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
61102F	2310	A1	

11. TITLE (Include Security Classification): EVALUATING EVAPORATION WITH SATELLITE THERMAL DATA

12. PERSONAL AUTHOR(S): A. Woodruff Miller and Eric L. Millis

13a. TYPE OF REPORT: FINAL

13b. TIME COVERED: FROM 870401 TO ______

14. DATE OF REPORT (Year, Month, Day): NOV 87

15. PAGE COUNT: 116

16. SUPPLEMENTARY NOTATION

17. COSATI CODES		
FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

Water surface temperatures can be obtained from satellite thermal remote sensing. Landsat and other satellites sense emitted thermal infrared radiation on a regular basis over much of the earth's surface. Evaporation is accomplished by the net transport of mass from the water surface to the atmosphere. Energy for the change of state in part comes from the subsurface and passes through the surface conduction layer. ~~Therefore,~~ the latent transfer (evaporation) predominantly determines the water surface temperature. ~~Hence,~~ there should be good correlations between evaporation and surface temperatures. → next page

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION: Unclassified

22a. NAME OF RESPONSIBLE INDIVIDUAL: James P. Koermer, Lt Col, USAF

22b. TELEPHONE (Include Area Code): (202) 767-4960

22c. OFFICE SYMBOL: NC

DD Form 1473, JUN 86 — Previous editions are obsolete.

SECURITY CLASSIFICATION OF THIS PAGE

Previous investigations on Utah Lake with satellite-derived temperatures and pan- and model-derived evaporations have produced good correlations. The relationships which were developed have been applied at other dates on Utah Lake and on Lake Powell and Lake Havasu with some success. However, more study was required with additional satellite data and evaporation measurements for saltwater conditions. The applicability of this method for estimating evaporation on Utah's Great Salt Lake was of particular interest at this time because of the unprecedented rise of this terminal lake and because of the similarities with ocean evaporation.

Satellite thermal data and evaporation data from four different years were obtained for the Great Salt Lake and surrounding region. More than 350 correlation and linear regression analyses were performed on the temperature and evaporation data. These included daily, multiple-day, and monthly values from measurements and modeling for the whole lake and areas within the lake using both day and night observations. The lake salt concentrations were also factored into the analyses in several different ways. The correlation results were generally very good and a methodology for using satellite-derived water surface temperatures along with salt concentrations was developed to estimate evaporation. Continuing efforts now include acquiring thermal data at less cost, more frequently and more quickly in order to apply the temperature evaporation models in near real time to lakes and the ocean.

EVALUATING EVAPORATION WITH
SATELLITE THERMAL DATA

AFOSR-TR- 88-0131

by

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and
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Brigham Young University
Civil Engineering Department

for

U.S. Air Force Office of Scientific Research

Grant No. AFOSR-87-0177

November 1987

88 2 26 045

Completed Project Summary

1. **Title:** Evaluating Evaporation with Satellite Thermal Data

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3. **Inclusive Dates:** 1 April 1987 - 1 October 1987

4. **Grant Number:** AFOSR-87-0177

5. **Costs & FY Source:** $9,944.00

6. **Senior Research Personnel:** Woodruff Miller

7. **Junior Research Personnel:** Eric Millis
   M.S. Student

8. **Publications:**

   1. "Using Thermal Infrared Satellite Imagery to Estimate Evaporation from the Great Salt Lake, Utah", Master's Thesis, BYU, Fall Semester, 1987.

   2. Technical paper for Water Resources or Remote Sensing Journal, pending.

9. **Abstract and Executive Summary:** see attached

Abstract

Water surface temperatures can be obtained from satellite thermal remote sensing. Landsat and other satellites sense emitted thermal infrared radiation on a regular basis over much of the earth's surface. Evaporation is accomplished by the net transport of mass from the water surface to the atmosphere. Energy for the change of state in part comes from the subsurface and passes through the surface conduction layer. Therefore, the latent transfer (evaporation) predominantly determines the water surface temperature. Hence, there should be good correlations between evaporation and surface temperatures.

Previous investigations on Utah Lake with satellite-derived temperatures and pan- and model-derived evaporations have produced good correlations. The relationships which were developed have been applied at other dates on Utah Lake and on Lake Powell and Lake Havasu with some success. However, more study was required with additional satellite data and evaporation measurements for saltwater conditions. The applicability of this method for estimating evaporation on Utah's Great Salt Lake was of particular interest at this time because of the unprecedented rise of this terminal lake and because of the similarities with ocean evaporation.

Satellite thermal data and evaporation data from four different years were obtained for the Great Salt Lake and surrounding region. More than 350 correlation and linear regression analyses were performed on the temperature and evaporation data. These included daily, multiple-day, and monthly values from measurements and modeling for the whole lake and areas within the lake using both day and night observations. The lake salt concentrations were also factored into the analyses in several different ways. The correlation results were generally very good and a methodology for using satellite-derived water surface temperatures along with salt concentrations was developed to estimate evaporation. Continuing efforts now include acquiring thermal data at less cost, more frequently and more quickly in order to apply the temperature evaporation models in near real time to lakes and the ocean.

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Linear Regression Results for Surface Temperatures Versus Evaporations:

EXECUTIVE SUMMARY

Over the past several years, research has been conducted to determine the feasibility of using remote infrared sensing satellites to aid in the estimation of evaporation from lakes and reservoirs. These past studies have indicated in the affirmative and the aim of this study is to better define the limits of the method, particularly in estimating the evaporation from a saline body of water.

The Great Salt Lake, located in Northern Utah, was used as the study area because of its high salinity and because of its close proximity to Hill Air Force Base. Due to the rapid rise of the level of the lake over the past few years, the amount of outflow due to evaporation has become more of a concern. Since the lake is terminal, evaporation is its only real outflow and is thus tied directly to the level of the lake.

Orbital satellites capable of detecting thermal infrared radiation scan the earth creating a temperature map that for even large areas of the earth's surface is nearly instantaneous. One of the primary goals of this study was to develop equations that would estimate the evaporation from the Great Salt Lake given only the surface temperature of the lake. These equations are developed by performing a linear regression between the surface temperature for a given day or the average of several days and evaporation pan data or synthesized evaporation data for the same time period.

Several approaches were taken in trying to develop reliable temperature-evaporation models that would take into account the large areal extent of the lake and its variable salinity. More than 350 correlations were performed which included correlating daytime surface temperatures with:

1. Daily and monthly pan evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

2. Daily and monthly equivalent lake evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

3. Daily and monthly model evaporations
   a. for South Arm and Farmington Bay, and
   b. for regional averages.

Another approach was to correlate the nighttime surface temperatures with:

1. Daily and monthly pan evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

2. Daily and monthly equivalent lake evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

Two other approaches that were evaluated were:

1. Temperature/salinity ratios versus pan evaporations, and

2. Salt temperatures versus pan evaporations.

Some of these approaches worked well, while others did not, but seemingly good and reliable equations were developed for the entire lake and for smaller areas of it. The best equations developed were assumed to be those for which there were sufficient surface temperature and evaporation data and high correlation coefficients between these data. Many of the correlation coefficients ranged from the 85% to 97% and were considered usable.

Evaporation was modeled for monthly and short-term periods of one, two and three days. Most of the better models represent the monthly evaporation, however there were some which would estimate the evaporation for the short-term very effectively. Morton's (1985) climatologically-based model (WREVAP)

provided evaporation estimates that correlated very well with the surface temperatures and was used to develop several equations. The output with this model also showed a nearly one-to-one relationship with pan evaporations from the Saltair pan thus confirming its reliability.

A major conclusion drawn from the correlation results was that salinity effects can be successfully factored into the evaporation-temperature relationships. Accurate saltwater lake evaporations are determined by multiplying the results from the equations developed to yield pan evaporations by the appropriate pan and salt coefficients. The results of this study show that the modeling was successful, demonstrating that the evaporation from saline bodies of water can be effectively estimated using remote sensing techniques.

INTRODUCTION

Over the past several years, research has been conducted to determine the feasibility of using remote sensing satellites to aid in the estimation of evaporation from lakes and reservoirs. These satellite radiometers, determine the water's surface temperature which can then be related to its evaporation by a mathematical equation or "model". Studies on fresh-water Utah Lake, Lake Powell, and Lake Havasu have indicated that evaporation can be modeled in this manner with a good deal of success. The purpose of this similar study on the Great Salt Lake is to further investigate the method and determine the effects that salinity and the varied climate over the lake have on it.

THE GREAT SALT LAKE

The Great Salt Lake shown in Figure 1, located in Northern Utah, is a highly saline, terminal lake from which there is no outflow except for evaporation. In a recent presentation, Lloyd Austin, of the Utah Division of Water Resources pointed out that over the long term, evaporation from the lake has been about 3 million ac-ft/yr based on a water budget approach. Approximately the same amount flows into the lake so that over the long term there is no net rise or drop of the lake's surface. However, during the period of 1982 to 1985, the inflow exceeded the evaporation causing the lake to rise and flood property adjacent to it. This increased surface area and decrease in salinity, due to dilution, have increased the annual evaporation to approximately 4 million ac-ft/yr.

The rise in the lake's level caused millions of dollars in damage due to extensive flooding. The evaporation from the lake is of particular concern because it is the only outflow from the lake and thus tied directly to the level of the lake. Eubanks and Brough (1980) report that the Great Salt Lake

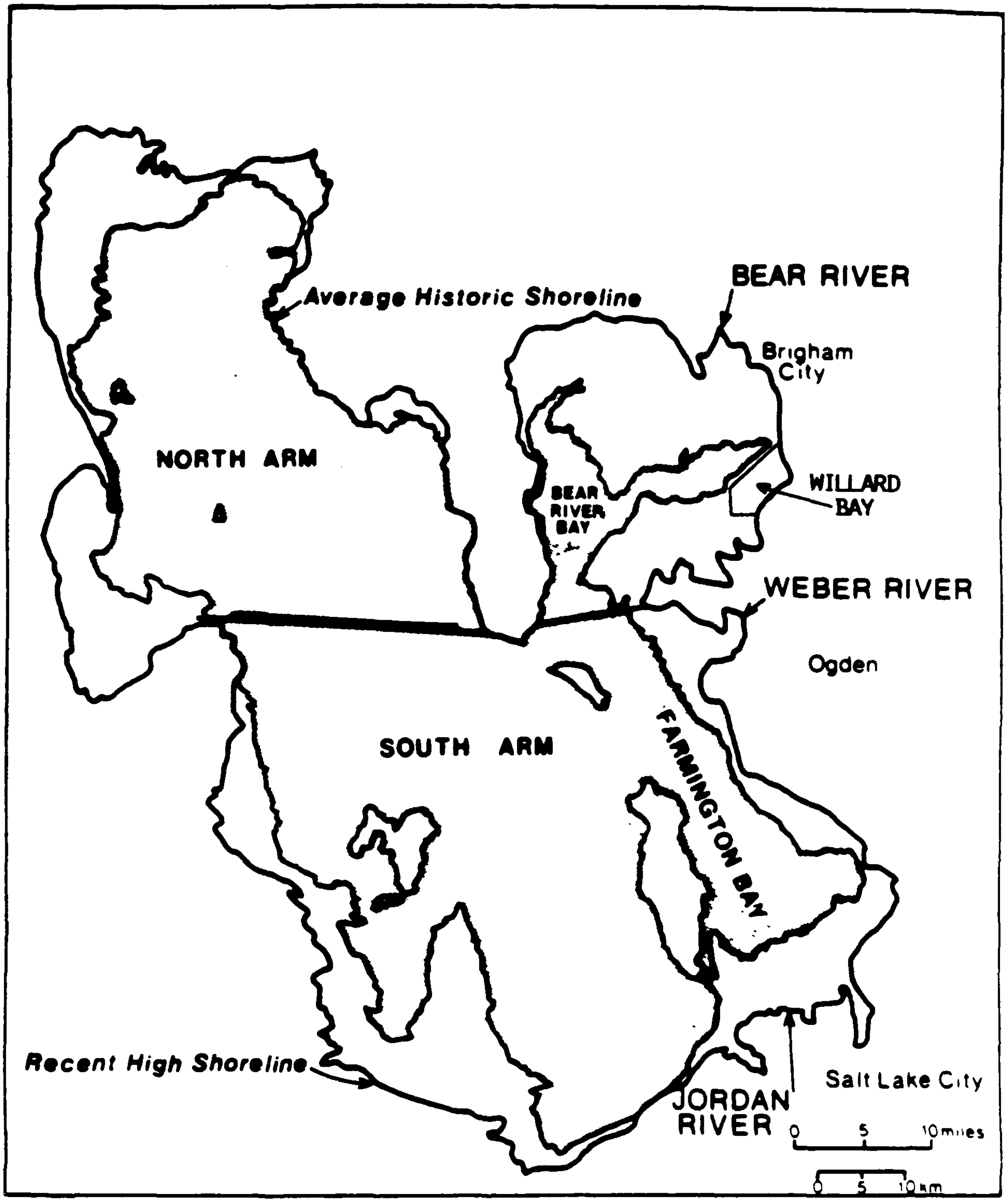


Figure 1. The Great Salt Lake and Its Major Areas, Showing the Average Historic Shoreline and the Recent High Shoreline (After Currey, 1980).

also affects the local temperature, precipitation and wind patterns, and that local storms are enhanced to some degree by the evaporation from the lake.

EVAPORATION THEORY

In order for water to evaporate, there must be an energy source to supply the 600 calories required to vaporize each gram of water. Saltwater evaporates at a slower rate than freshwater, thus the excess energy which is not used to evaporate the saltwater is absorbed by the water, causing its temperature to rise. Salinity reduces evaporation primarily because of a reduction in the vapor pressure of the saline water. Jones (1933) mentions that cohesive forces acting between the dissolved ions and the water molecules may also be responsible for inhibiting evaporation, making it more difficult for the water to escape as vapor. Figure 2 shows a comparison of freshwater and saltwater evaporations as a function of surface temperature.

Evaporation rates are influenced by solar radiation, air temperature, atmospheric pressure, vapor pressure, wind, and surface temperature. Surface temperature is a function of incident solar radiation, evaporative cooling, heat transfer, and mixing with water beneath the surface. In still water there is a substantial temperature gradient within the first few centimeters of the surface and any mixing due to wave action or other currents can alter the surface temperature significantly.

METHODS

Estimating evaporation by remote sensing techniques involves developing an equation, or model, by correlating evaporation data with surface temperature data from the satellite imagery. One basic assumption of estimating evaporation from a particular lake by remote sensing techniques is that

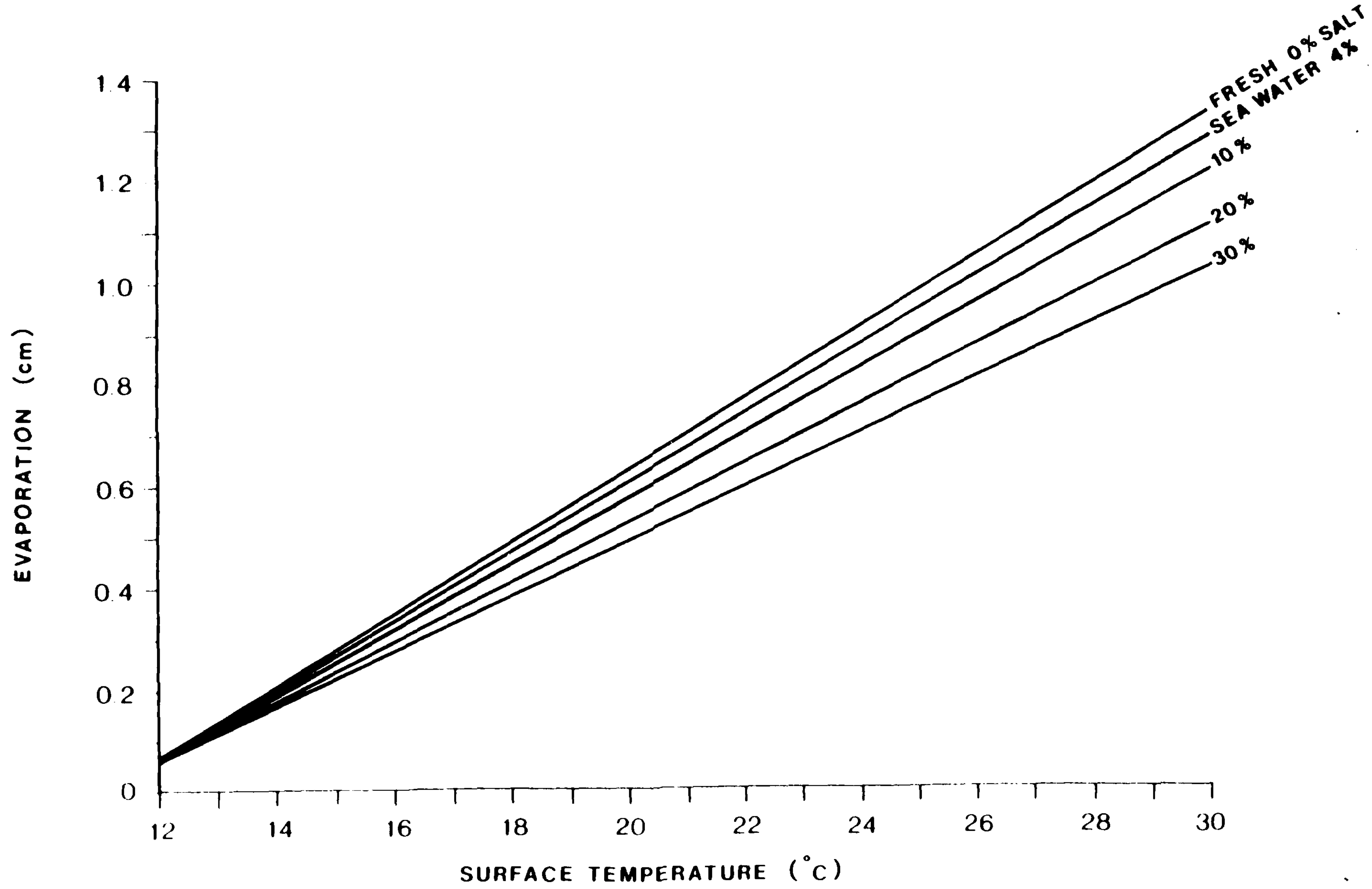


Figure 2. Plot of Decreased Evaporation Due to Increased Salinity

evaporation is largely a function of surface temperature. For the large lakes and specific years that have been studied thus far, this has been shown to be generally true. These studies have also shown that evaporation is a linear function of surface temperature defined by an equation of the form:

$$\text{Evaporation} = a + b \cdot \text{Surface temperature}$$

where a and b are respectively the intercept and slope of the line.

Figure 3 shows a plot of evaporation data versus surface temperature. It is assumed that the climatological factors listed above are responsible for the scatter of data points around the best-fit straight line. The effects of atmospheric moisture and atmospheric pressure were assumed to be constant since they were nearly constant on the days that the satellite measured the surface temperature. Wind was also not considered to increase evaporation substantially since this is generally the case with large lakes. These assumptions, however, may not be entirely correct and an analysis should be made of the results of atmospheric changes and possible correction functions should be developed.

The temperature-evaporation model is obtained by correlating the surface temperatures with evaporation values for the same time period. Both pan evaporation data and evaporation estimates generated by a climatologically based model can be used to develop and calibrate the model. Once the model has been developed, only surface temperatures and salinities need to be input to get lake evaporations. It is important to note that each individual model is valid only for the particular lake or section of the lake for which it was developed. Figure 4 shows the differences in the temperature-evaporation models for freshwater Utah Lake and freshwater Willard Bay.

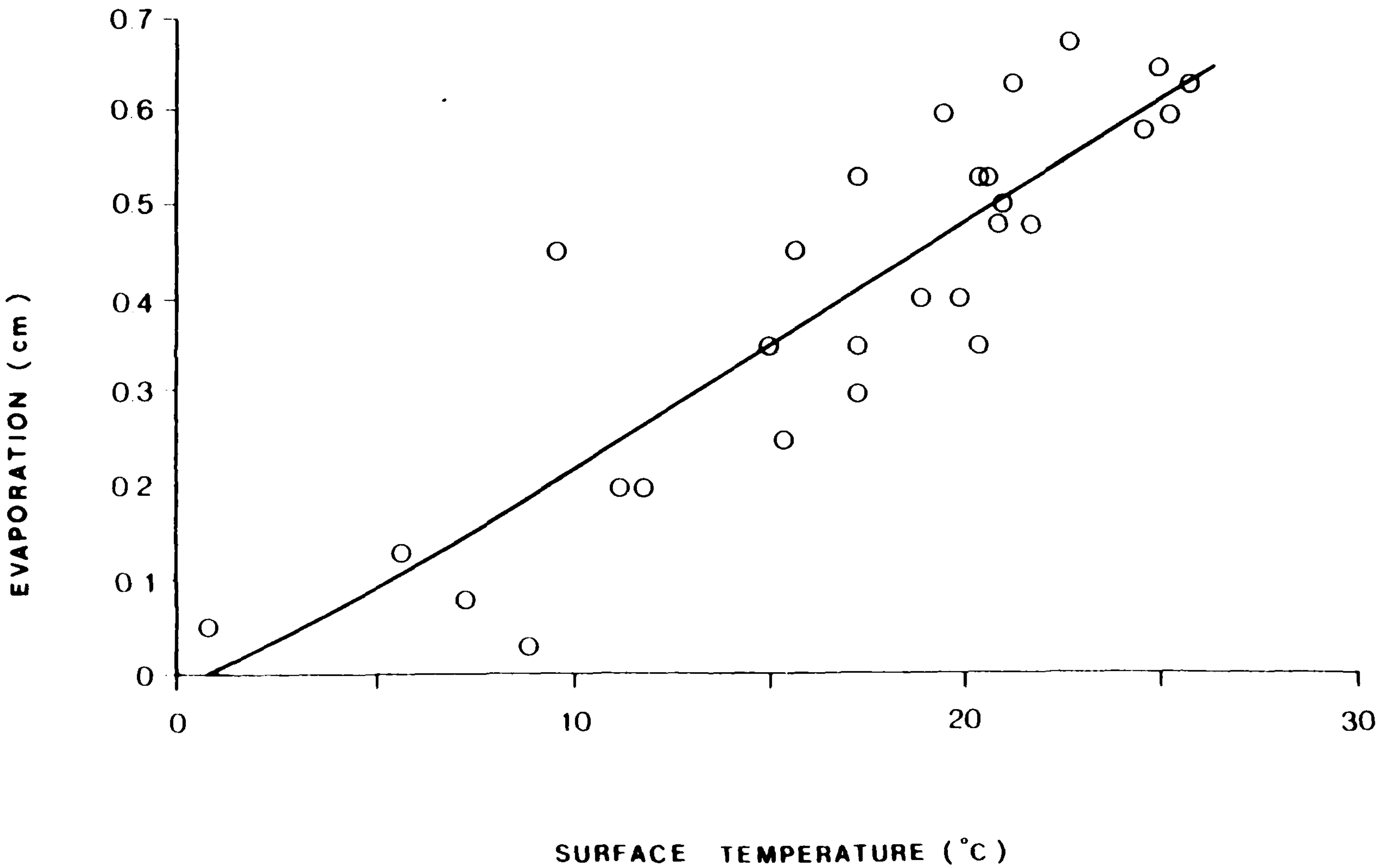


Figure 3. Plot of Evaporation Data Vs. Lake Surface Temperature.

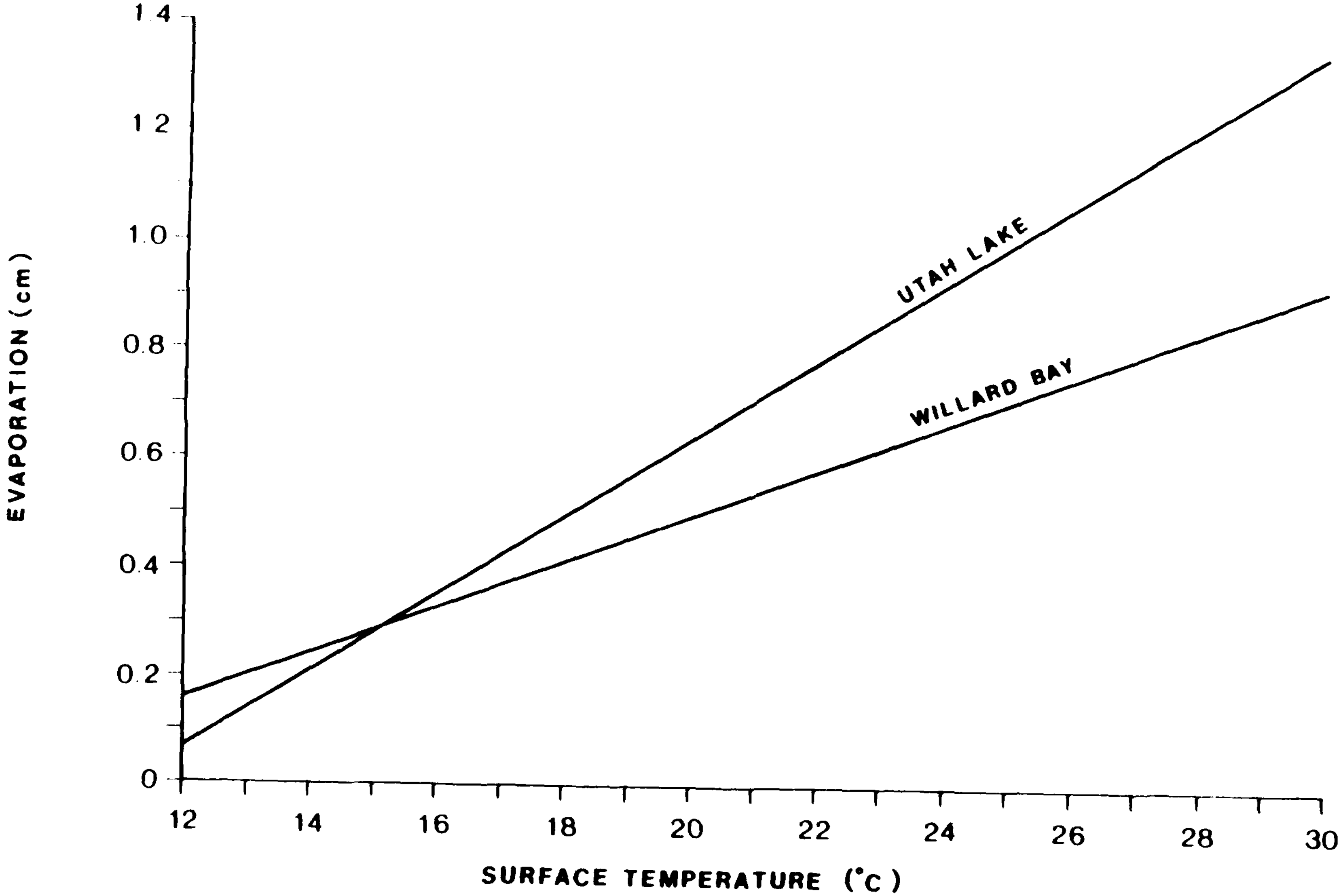


Figure 4. Comparison of Evaporation Modeled For Willard Bay and Utah Lake as a Function of Surface Temperature

DATA

CLIMATOLOGICAL DATA

Local weather stations from which pan evaporation data were obtained were the Bear River Refuge Station, the Saltair Station, the Utah Lake-Lehi Station, and the Logan Experimental Farm Station. Equivalent freshwater lake evaporations were obtained by multiplying the pan evaporations by a pan coefficient of 0.7. This value of 0.7 for the Great Salt Lake was obtained from a study by Waddell and Fields (1977) of several evaporation pans around the lake. All measured evaporation data used in this study are given in Appendix A. Climatological data from the Salt Lake City Airport Weather Station were used as input to F. I. Morton's (1985) climatologically-based computer model WREVAP which produced the model evaporations.

SALINITY DATA

In this study pan saltwater evaporations were obtained by multiplying pan data by salt coefficients which reduced the pan evaporation rates to that of saline water. These values were then multiplied by a pan coefficient of 0.7 to obtain saltwater lake evaporations.

The salt coefficients for this study were calculated using the saltwater/freshwater ratio versus sodium chloride content relationship developed by Jones (1933). His data are for a constant 20°C but are not significantly affected by temperature changes within the normal ranges of the Great Salt Lake's surface temperature. The sodium chloride was converted to TDS concentration and the curve showing the saltwater/freshwater evaporation ratios as a function of percent TDS is given in Figure 5. These ratios are, in fact, our salt coefficients and discrete values from the curve are given in the accompanying table.

Table of Salt Coefficients at Salt Concentrations

Percent Salt	Salt Coef.	Percent Salt	Salt Coef.	Percent Salt	Salt Coef.
1	0.997	11	0.944	21	0.867
2	0.994	12	0.936	22	0.860
3	0.990	13	0.928	23	0.853
4	0.986	14	0.920	24	0.846
5	0.982	15	0.912	25	0.839
6	0.977	16	0.904	26	0.833
7	0.972	17	0.896	27	0.828
8	0.966	18	0.888	28	0.823
9	0.959	19	0.881	29	0.818
10	0.952	20	0.874	30	0.813

Figure 5. Salt Concentration and Evaporation Ratio Data (After Jones, 1933)

Salt coefficients estimated by Waddell and Fields (1977) from field data from the Morton Salt Company were also reviewed, but the more conservative coefficients from Jones' data were preferred. Jones' relationship was the result of direct observation of the evaporation of Great Salt Lake water and freshwater under identical conditions. Salinity data expressed as percent salt content by weight are given in Appendix B.

Salinity data collected by the Utah Geologic and Mineral Survey (UGMS) for their sampling program were used for this study. The data included the concentrations of TDS along with its constituents at various depths. Sodium chloride concentrations at the surface for the time and locations needed were calculated from the UGMS data and entered into Jones' model to obtain the salt coefficients. Also see Appendix B for various relationships involving the TDS, lakewater density and sodium chloride concentration for the Great Salt Lake.

SATELLITE DATA

The satellite data available for use were from the Heat Capacity Mapping Mission Satellite (HCMM) and the Landsat V Satellite. More than 25 HCMM scenes were available for our use from the National Space Science Data Center. Four Thematic Mapper scenes from Landsat V, two from 1984 and two from 1986, have been purchased from EOSAT (Earth Observation Satellite Co). However, due to their high cost more Landsat data could not be obtained.

Both the HCMM and Landsat V satellites orbit the earth, scanning the surface with sensors capable of detecting both visible and thermal infrared electromagnetic energy. The sensors scan along the satellite's path in a side-to-side sweeping manner, seeing the earth as a series of strips of rectangular areas or picture elements called pixels. The sensor assigns to

each pixel a digital number that corresponds with its thermal emission. These digital data are then relayed to the earth where they are processed and distributed to users in digital form. Computers and graphics display monitors capable of handling sizable amounts of data are then employed to manipulate and view the data as needed.

Figure 6 shows day and night images of the Great Salt Lake from the HCMM scanner. Figure 7 shows Landsat images of the Great Salt Lake.

SURFACE TEMPERATURE DETERMINATION

For this study, a Digital/Vax 11/780 system was used in conjunction with a Tektronix 4115B Graphics Display (Figure 8) to prepare the data for processing and view it. An image processing program called PCIPS (Personal Computer Image Processing System), distributed by IBM, was then run on an IBM PC shown in Figure 8 to reduce the data to usable form.

The data, when displayed, are an array of pixels each of which represents an area on the ground. Each pixel has an intensity value ranging from 0 to 255 which corresponds to the thermal infrared emission and therefore the temperature of the area of water it represents.

Determining the average surface temperature of the Great Salt Lake was a very labor-intensive process, requiring several hours of time for each scene. The first step in the process was to copy the data from tape and store them in the computer's memory. Because the scenes cover a large area and contain substantial amounts of data outside the study area, they were then displayed on the Tektronix to locate the study area and determine where excess data could be removed. The excess was deleted leaving a much smaller file which could then be transferred to the PC to be manipulated by the image processing program.

a.

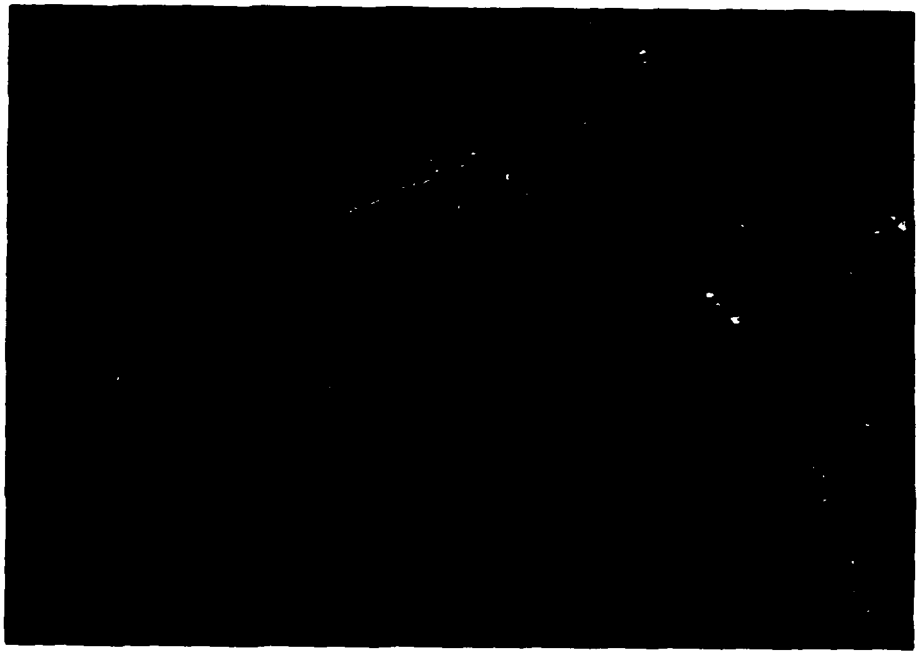
b.

Figure 6. HCMM 1979 Scenes of the Great Salt Lake Showing:
a. Daytime Thermal Infrared Imagery, and
b. Nighttime Thermal Infrared Imagery

c.

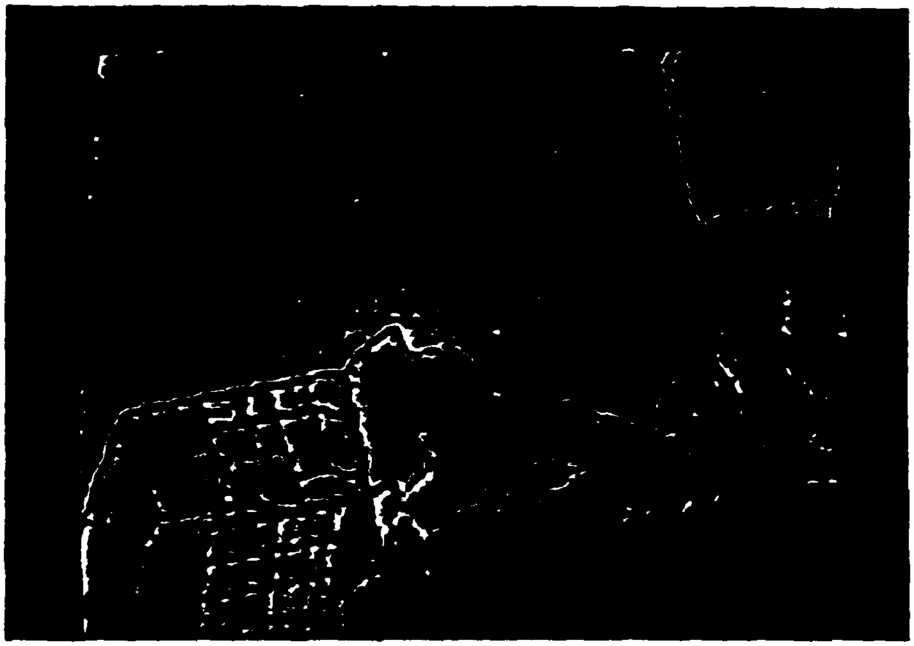
Figure 6. (cont.)
c. Daytime Visible Band Imagery

a.



b.

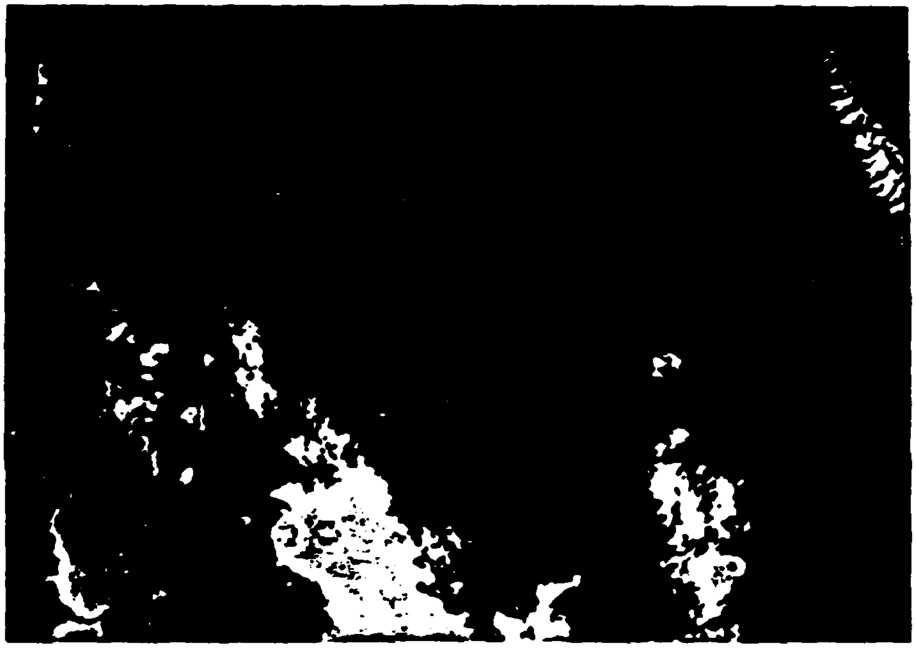
Figure 7. Landsat Scenes of the Great Salt Lake Showing:
a. False Color Infrared Image of the Bear River Bay, and
b. Daytime Thermal Infrared Image of the Bear River Bay.



c.

d.

Figure 7. (Cont.)
Close-ups of Daytime Thermal Infrared Imagery Showing:
c. Great Salt Lake Mineral Corp. Evaporation Ponds, and
d. The Southern Pacific Railroad's Causeway West of Promontory Point. (Note the swirling temp. patterns)



e.

Figure 7. (Cont.)
e. Daytime Thermal Imagery of the South Arm of the Great Salt Lake.
The Nebulous Light Blue and Red Formations in the Upper Left-Hand Corner
are Algae Blooms.

PCIPS displays the image of the study area in four colors. The first step in using the program was to delineate the boundaries of the lake by assigning the water surface one or two colors and then coloring the land and other features with the remaining colors. Since the land near the edge of the water may be the same temperature as the water itself, this delineation process was aided by comparing the thermal image with the visible band image that accompanies it.

Once the lake's boundaries had been located, PCIPS' "extract" feature was used to "block off" the water area inside them as shown in Figure 9. PCIPS then performed a statistical analysis showing a histogram of the pixel intensity values and calculated the average intensity value (I). This average intensity value is then converted to an average surface temperature (T) using one of the following equations:

GODDARD SPACE FLIGHT CENTER MODEL FOR HCMM DATA

$$T(^\circ C) = \frac{K_2}{\ln\left[\frac{K_1}{(I-K_3)}+1\right]} + K_0 - 273.16$$

$K_0 = 4.9$
$K_1 = 14421.587$
$K_2 = 1251.1591$
$K_3 = -118.21378$

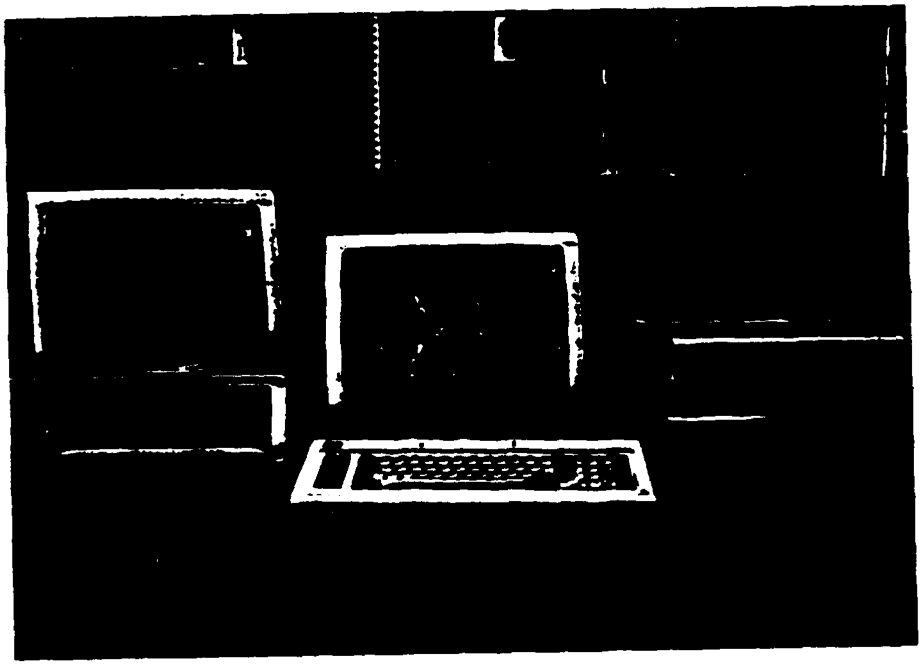
GODDARD SPACE FLIGHT CENTER MODEL FOR LANDSAT DATA

$$T(^\circ C) = \frac{K_7}{\ln\left[\frac{K_4}{K_5 \cdot I + K_6}+1\right]} - 273.16$$

$K_4 = 60.776$
$K_5 = 0.0057$
$K_6 = 0.1252$
$K_7 = 1260.56$

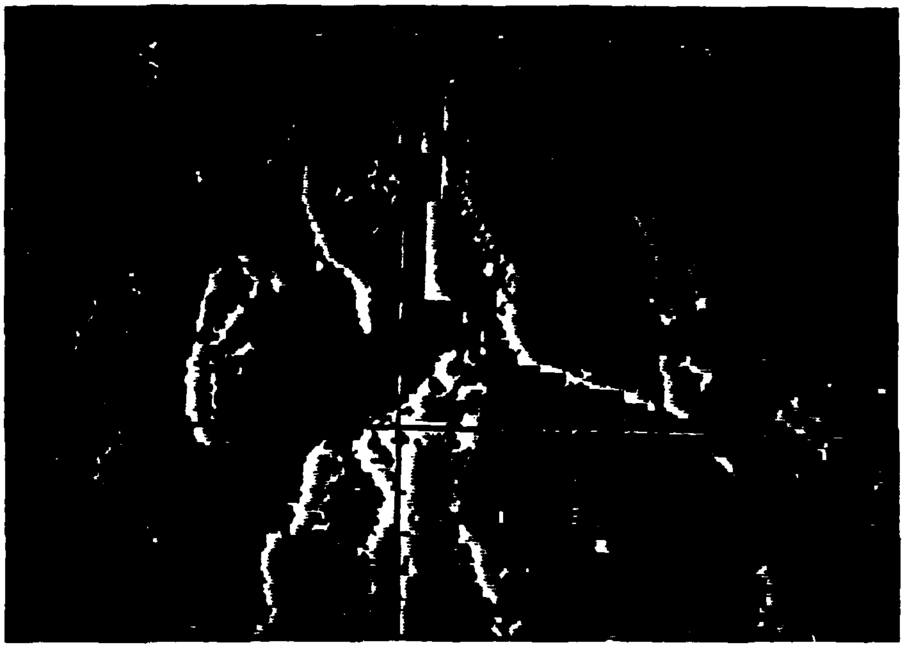
A total of 144 temperature determinations were made in this manner. An example of the PCIPS output is given in Appendix G.

a.



b.

Figure 8.
a. Tektronix 4115B Graphics Display, and
b. IBM PC Running PCIPS.

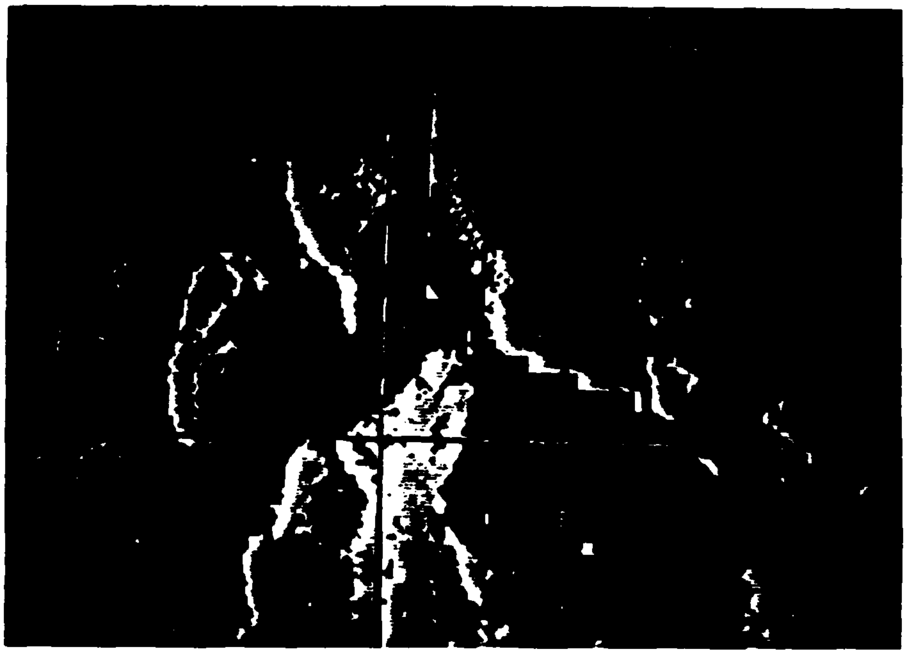


c.

d.

Figure 9. (Cont.)
c. Using Smaller Blocks to Approximate the Lake's Border, and
d. The Blocked Off North Arm Ready for Statistical Analysis.

a.



b.

Figure 9.
a. PCIPS Display of the Great Salt Lake, and
b. PCIPS "Extract" Feature Used to Block Off the North Arm.

DEVELOPING THE MODEL

Ideally, the aim of this project was to develop a temperature-evaporation model that would consider the large areal extent of the lake and its varying salt contents and be applicable for all conditions. Several approaches were conceived and tested in order to get the desired results. These included; correlating the daytime surface temperatures with:

1. Daily and monthly pan evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

2. Daily and monthly equivalent lake evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

3. Daily and monthly model evaporations
   a. for South Arm and Farmington Bay, and
   b. for regional averages.

Another approach was to correlate the nighttime surface temperatures with:

1. Daily and monthly pan evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

2. Daily and monthly equivalent lake evaporations
   a. from stations near the section being studied, and
   b. from regional averages.

Two other approaches that were evaluated were:

1. Temperature/salinity ratios versus pan evaporations, and

2. Salt temperatures versus pan evaporations.

Correlating these surface temperatures with the evaporations was simplified by the use of Lotus 1-2-3, which is an electronic spreadsheet program for the IBM PC. The spreadsheet performed linear regressions on the data to determine the equation of the temperature-evaporation model and the correlation coefficient of the data.

Due to its large size, the lake was divided into four main areas; the North Arm, South Arm, Bear River Bay and Farmington Bay (Figure 1). Surface

temperatures from these individual areas were correlated with evaporation data from their closest weather station. Additionally, the average surface temperatures of several combined areas were correlated with the regional average evaporations from the four stations listed earlier. The equivalent saltwater lake evaporation was obtained by multiplying the pan evaporation by a pan coefficient of 0.7 and the salt coefficient which was dependent on the salinity of the lake. Due to the fact that only the Salt Lake City Airport Weather Station provided the appropriate data to input into the Morton Model, the model evaporations were only correlated with the temperatures from the southern part of the lake.

The satellites from which data for this study were obtained did not provide daily coverage of the Salt Lake, but covered it only once in a given number of days. For HCMM this was approximately five days and for Landsat it was sixteen days. Since daily coverage was not provided, the surface temperature for a satellite overpass day was correlated with the evaporation for that same day, the day before and the day after. Temperatures were also correlated with the two-day average evaporation consisting of the day before and same day and with the three-day average evaporation of all three days. Where there was more than one surface temperature for a month or where a single temperature was measured near the middle of the month, these temperatures were averaged and correlated with monthly evaporation data.

RESULTS

Tables 1 - 11 present the results of all the correlations between surface temperatures and evaporations and will be discussed individually. These results include r, the correlation coefficient, n, the number of observations, and a and b, the regression coefficients to be used in the equation:

$$E = a + b \cdot T \quad (E = \text{lake evaporation}, T = \text{surface temperature}).$$

AREA PAN EVAPORATION

The first attempts at creating a model involved correlating surface temperatures for a single area of the lake with pan evaporations from the nearest weather station. The South Arm and Farmington Bay temperatures were correlated with the Saltair pan data, and the North Arm, Bear River Bay and Willard Bay temperatures with the Bear River Refuge pan data. These results are given in Tables 1 and 2.

Correlating the daytime surface temperature with the pan evaporation for the same-day the temperature was sensed, yielded correlation coefficients ranging from 67 to 78% with an average of 74%. The correlations coefficients with the Saltair pan were slightly higher, with an average 78%, than those with the Bear River Refuge pan which averaged 71%.

The overall best daily correlations were the surface temperature against the evaporation for the day-before the temperature was sensed. These correlation coefficients ranged from 75 to 85% with an average of 80%. These good results may be due to the fact that the surface temperature is, in a large part, a function of the evaporation from the day before. There is very little mixing of the stratified layers of brine in the lake's profile. Perhaps the upper layer is cooled by evaporation from the day-before to a temperature that correlates well with the evaporation from the day-before.

TABLE 1

Correlation and Linear Regression Results[1] for Great Salt Lake South Area Satellite Temperatures versus Saltair Evaporations

Temperature Area		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
South Arm	r =	0.78	0.79	0.77	0.80	0.78	0.84
	a =	−0.224	−0.229	−0.113	−0.230	−0.159	-3.301
	b =	0.057	0.059	0.048	0.058	0.054	1.702
	n =	24	22	21	24	24	11
Farmington Bay	r =	0.77	0.75	0.79	0.79	0.80	0.92
	a =	−0.235	−0.204	−0.203	−0.266	−0.226	-11.911
	b =	0.056	0.055	0.051	0.059	0.056	2.040
	n =	21	20	18	21	21	10
				Lake Evaporations[2]			
South Arm	r =	0.79	0.80	0.77	0.81	0.79	0.83
	a =	−0.156	−0.158	−0.079	−0.162	−0.112	-1.793
	b =	0.038	0.039	0.032	0.039	0.035	1.092
	n =	24	22	21	24	24	11
Farmington Bay	r =	0.78	0.75	0.75	0.79	0.80	0.91
	a =	−0.173	−0.159	−0.094	−0.193	−0.161	-8.174
	b =	0.038	0.038	0.032	0.040	0.038	1.381
	n =	21	19	18	21	21	10

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[1]Results include r, the correlation coefficients; a & b, the regression coefficients in the equation $E = a + b \cdot T$ (E = evaporation and T = temperature); and n, the number of observations.

[2]Lake evaporation is pan evaporation times the pan coefficient (0.7) times the respective lake area salt coefficient.

TABLE 2

Correlation and Linear Regression Results for Great Salt Lake North Area Satellite Temperatures versus Bear River Refuge Evaporations

Temperature Area		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
North Arm	r =	0.67	0.80	0.57	0.76	0.74	0.90
	a =	−0.834	−0.493	−0.444	−0.415	−0.322	-10.925
	b =	0.069	0.061	0.052	0.054	0.048	1.480
	n =	14	18	15	18	17	7
Bear River Bay	r =	0.77	0.85	0.81	0.80	0.84	0.97
	a =	−1.025	−0.386	−0.609	−0.328	−0.278	-10.819
	b =	0.078	0.056	0.061	0.050	0.046	1.416
	n =	13	17	14	17	16	7
Willard Bay[1]	r =	0.70	0.83	0.73	0.81	0.85	0.93
	a =	−0.831	−0.531	−0.518	−0.497	−0.428	-10.406
	b =	0.071	0.065	0.061	0.060	0.056	1.482
	n =	14	18	15	18	17	7
				Lake Evaporations			
North Arm	r =	0.67	0.80	0.65	0.75	0.78	0.90
	a =	−0.539	−0.314	−0.281	−0.269	−0.218	-6.284
	b =	0.043	0.037	0.032	0.033	0.030	0.854
	n =	14	18	14	18	16	7
Bear River Bay	r =	0.76	0.84	0.81	0.79	0.83	0.97
	a =	−0.692	−0.266	−0.406	−0.228	−0.192	-6.709
	b =	0.053	0.038	0.041	0.034	0.031	0.917
	n =	13	17	14	17	16	7

[1]Because Willard Bay is fresh water, Willard Bay lake evaporation correlation coefficents are the same as the pan evaporation correlation coefficents. However, the linear regression coefficients a & b should each be multiplied by the pan coefficent (0.7) to define the Willard Bay temperature-lake evaporation relationship.

The day-before evaporation versus surface temperature correlations were better for the Bear River Refuge pan than the Saltair pan.

Correlation coefficients for the daytime surface temperatures versus the evaporation for the day-after the temperature was sensed ranged from 57 to 81% with an average of 73%. These correlations were in close agreement with the same-day correlations, but this time some of the Bear River Refuge correlations were better than those with the Saltair pan. The Saltair average correlation coefficient was, however, slightly higher than its Bear River Refuge counterpart at 78% versus 70%. If the surface temperature is a function of the heat capacity of the lake and the evaporation from the day-before, then the surface temperature is not so much affected by the evaporation from the same-day or day-after. This may also be influenced by the fact that the satellite flies over at approximately midday, before much of the day's evaporation has taken place.

The Saltair multiple day evaporations (i.e. two-day and three-day) when correlated with the surface temperatures gave correlations that were about the same as the best of their constituent single day correlations. This was not true with the Bear River correlations because of the greater difference in the correlation coefficients for the same-day and day-after in comparison with those for the day-before. Here the averaging effect of the high day-before correlation was evident, but the multiple day correlation coefficients were still 2 to 5 percentage points lower than those for the day-before.

Total monthly pan evaporations correlated with the average surface temperature for the whole month yielded coefficients ranging from 84% to 97% with an average of 90%. This is significantly higher than those for the shorter periods within the month partly because the monthly total is more stable and is not greatly affected by a brief period of atypical weather.

AREA LAKE EVAPORATION

The first approach to studying the salt effects on the correlations was to change the pan evaporation to an equivalent lake evaporation by multiplying it by the salt coefficient and the pan coefficient. Tables 1 and 2 show that this changed the correlation coefficients from those in which straight pan evaporations were considered, but not enough to be significant in most cases. There was a substantial drop in the correlation for the monthly Bear River evaporation after multiplying by the salt coefficient. This approach did, however, provide a model representing the relationship between saltwater lake evaporation and surface temperature.

The period that was studied, 1978-86, saw as great of variation in the lake's salinity as might ever again occur. Salinity ranged from 28.8% to 15.1% in the North Arm and 14.8% to 4.8% in the South Arm over this period of time. Although the effects of the salt on the correlations were not significant, it would seem that this approach would work better for long periods of time if there were not significant variations in the salt content. Additional data from the period of low salinity, 1983-86, would help substantiate this tentative conclusion.

Willard Bay is a small, freshwater reservoir located along the East edge of Bear River Bay. Correlations of the Willard Bay temperature with the Bear River Refuge pan were very similar to those for the Bear River Bay temperature versus the Bear River Refuge pan. This may be due, in part, to the low salinity of the Bear River Bay. The Willard Bay correlations were always better than those for the highly saline North Arm. There was no way to make meaningful comparisons with correlations with other pans to know if the freshwater was actually responsible for the better correlations.

REGIONAL PAN EVAPORATION

Due to the extreme size of the lake, pan averages from around the region were also used. Regional evaporation is the average of the pan measurements at the Utah Lake-Lehi, Saltair, Bear River Refuge, and Logan Experimental Farm Stations. These are thought to be more representative of the evaporation from the whole lake than comparisons with individual pans. Consequently, the surface temperatures of the four areas of the lake were averaged in different combinations and correlated with these regional average evaporations. Another reason for this approach was to stabilize the day to day variability of pan data at Saltair and to offset the effects of missing data from the Bear River Refuge station.

Much better correlations were obtained by comparing regional pan averages with the whole lake and sectional temperatures than were found by comparing an area temperature with a nearby pan. The regional evaporation and sectional temperature results are given in Table 3.

Comparing the arithmetic average Whole-lake temperature for a particular day with the regional pan average for the same-day yielded a 82% correlation coefficient (Table 3a). The correlation for the day-before was the best at 90% and for the day-after was again 82%. Consistent with the results presented thus far, the day-before correlations were always the best.

Likewise consistent with the individual area correlations were the average Whole-lake temperatures versus the regional pan averages for two and three-day periods. These correlation coefficients were a very good 91%. The monthly correlation was, however, higher with a correlation coefficient of 93%. This is also consistent with the results for the single areas of the lake.

South Lake, Southeast Lake, and North Lake average temperatures were also correlated with the regional average pan evaporation with good results. The

TABLE 3a

Correlation and Linear Regression Results for Great Salt Lake Sectional[1] Satellite Temperatures versus Regional Evaporations[2]

Unweighted[3] Temperature Section		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
Whole Lake	r =	0.82	0.90	0.82	0.91	0.91	0.93
	a =	-0.270	-0.373	-0.281	-0.343	-0.359	-9.061
	b =	0.049	0.056	0.052	0.053	0.055	1.610
	n =	23	25	24	25	24	12
South Lake	r =	0.86	0.89	0.86	0.90	0.91	0.92
	a =	-0.262	-0.358	-0.238	-0.315	-0.342	-9.303
	b =	0.048	0.055	0.048	0.052	0.054	1.634
	n =	21	22	21	22	21	12
Southeast Lake	r =	0.87	0.90	0.87	0.90	0.90	0.92
	a =	-0.289	-0.355	-0.264	-0.370	-0.303	-9.303
	b =	0.050	0.055	0.050	0.056	0.052	1.634
	n =	23	24	23	23	24	12
North Lake	r =	0.88	0.91	0.85	0.92	0.92	0.97
	a =	-0.296	-0.400	-0.244	-0.353	-0.340	-11.794
	b =	0.050	0.057	0.047	0.054	0.053	1.695
	n =	20	21	21	21	21	11

[1]A lake section is the combination of 2 or more lake areas. South Lake is South Arm and Farmington Bay, Southeast Lake is South Lake plus Bear River Bay, and North Lake is North Arm and Bear River Bay.

[2]Regional evaporation is the average of pan measurements at Utah Lake-Lehi, Saltair, Bear River Refuge, and Logan Experimental Farm.

[3]When lake areas were combined to form lake sections the temperatures were averaged to obtain unweighted sectional temperatures. Weighted sectional temperatures were determined by weighting the lake area temperatures according to surface area.

South Lake average temperature was an average of the South Arm and Farmington Bay temperatures. It showed correlation coefficients of 86% for the same-day and day-after correlations and 89% for the day-before following previously observed trends. These correlations were better than the Whole-lake correlations. Correlating the two and three-day and monthly regional pan evaporation averages with the South Lake temperatures gave correlation coefficients just slightly higher than those for the best of the single day averages. This is also consistent with the previously observed patterns.

The Southeast Lake average was comprised of temperatures from the South Arm, Farmington Bay and Bear River Bay. These temperatures were correlated with the regional pan evaporations producing correlation coefficients that were essentially the same as those for the South Lake for the all the daily and monthly correlations.

The North Lake temperatures, being the average of the North Arm and Bear River Bay temperatures, were also correlated with the regional pan evaporations and produced correlation coefficients that were the highest of all the regional pan versus sectional temperature correlations. The coefficients ranged from 85 to 92% for the same-day, day-before, day-after, two-day and three-day correlations, but the monthly correlation was the highest of the group at 97%.

Since the four areas of the lake being averaged for the sectional temperatures are of differing sizes, weighted averages, based on size, were calculated and correlated with the regional pan averages. The weighted average temperature for the Whole-lake, for example, was based on one Bear River Bay, one Farmington Bay, two North Arm and two South Arm temperatures. Table 3b shows that, in some cases, the weighted average had better correlations than the arithmetic average of the lake temperatures, but in most

TABLE 3b

Correlation and Linear Regression Results for Great Salt Lake Sectional Satellite Temperatures versus Regional Evaporations

Weighted Temperature Section		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
Whole Lake	r =	0.87	0.89	0.84	0.91	0.91	0.91
	a =	−0.304	−0.369	−0.261	−0.347	−0.361	-8.433
	b =	0.050	0.056	0.049	0.054	0.055	1.589
	n =	24	25	24	25	24	12
South Lake	r =	0.85	0.88	0.86	0.89	0.91	0.91
	a =	−0.267	−0.366	−0.251	−0.322	−0.358	-9.549
	b =	0.049	0.056	0.049	0.053	0.055	1.666
	n =	21	22	21	22	21	10
Southeast Lake	r =	0.87	0.89	0.87	0.91	0.92	0.96
	a =	−0.297	−0.348	−0.273	−0.339	−0.360	-8.771
	b =	0.051	0.055	0.051	0.053	0.055	1.612
	n =	23	22	23	24	23	12
North Lake	r =	0.87	0.90	0.84	0.92	0.91	0.96
	a =	−0.293	−0.388	−0.235	−0.349	−0.333	-10.820
	b =	0.049	0.057	0.047	0.053	0.052	1.645
	n =	20	21	21	21	21	11

cases the correlation coefficients were lower or unchanged. Therefore a simple arithmetic average of the surface temperatures would suffice in performing the multiple-area temperature versus regional average pan correlations.

REGIONAL LAKE EVAPORATION

Using lake evaporations instead of pan evaporations changed the correlations only slightly (Table 3c). In some cases the change was for the better and other cases for the worse, but never enough to be really significant. Correlations using the weighted average temperature of the sections of the lake (Table 3d) were slightly lower than those using the unweighted lake temperatures. This helps confirm the conclusion that there is no need to calculate a weighted average temperature instead of a simple arithmetic average temperature.

NIGHT TEMPERATURES

HCMM satellite nighttime temperatures were available for several days in 1978 and 1979. As before, the nighttime temperatures for each of the five areas of the lake were correlated with the nearest pan for the same-day, day-before, day-after and two and three-day averages. Miller and Rango (1985), in their study on Utah Lake, found that the nighttime temperatures actually yielded the best results when correlated with two-day evaporation averages. This is because the night temperatures more accurately reflect the actual heat storage of the lake and are less affected by surface heating due to an occasional very hot and windy day. Similarly, the two-day evaporation averages better approximate long-term conditions than do evaporation values from a single day.

TABLE 3d

Correlation and Linear Regression Results for Great Salt Lake Sectional Satellite Temperatures versus Regional Evaporations

Weighted Temperature Section		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Lake Evaporations			
Whole Lake	r =	0.86	0.89	0.83	0.90	0.90	0.90
	a =	-0.202	-0.243	-0.175	-0.229	-0.235	-6.022
	b =	0.032	0.036	0.032	0.034	0.035	1.047
	n =	24	25	24	25	24	12
South lake	r =	0.85	0.88	0.85	0.89	0.90	0.90
	a =	-0.180	-0.241	-0.167	-0.215	-0.237	-6.692
	b =	0.032	0.037	0.033	0.035	0.036	1.129
	n =	21	22	21	22	21	10
Southeast Lake	r =	0.87	0.89	0.87	0.91	0.92	0.91
	a =	-0.203	-0.240	-0.189	-0.229	-0.243	-6.189
	b =	0.034	0.037	0.034	0.036	0.037	1.087
	n =	23	24	23	24	23	12
North Lake	r =	0.86	0.90	0.83	0.91	0.90	0.95
	a =	-0.182	-0.242	-0.148	-0.218	-0.212	-7.146
	b =	0.030	0.035	0.029	0.033	0.032	1.031
	n =	20	21	21	21	21	11

TABLE 3c

Correlation and Linear Regression Results for Great Salt Lake Sectional Satellite Temperatures versus Regional Evaporations

Unweighted Temperature Section		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Lake Evaporations			
Whole Lake	r =	0.86	0.90	0.84	0.91	0.89	0.92
	a =	-0.195	-0.244	-0.173	-0.225	-0.203	-6.191
	b =	0.032	0.036	0.032	0.034	0.033	1.048
	n =	24	25	24	25	25	12
South Lake	r =	0.86	0.89	0.86	0.90	0.91	0.90
	a =	-0.177	-0.235	-0.158	-0.211	-0.226	-6.339
	b =	0.032	0.037	0.032	0.034	0.036	1.099
	n =	21	22	21	22	21	10
Southeast Lake	r =	0.87	0.90	0.87	0.91	0.92	0.92
	a =	-0.198	-0.238	-0.183	-0.224	-0.235	-6.509
	b =	0.033	0.037	0.034	0.035	0.036	1.099
	n =	23	24	23	24	23	12
North Lake	r =	0.86	0.91	0.83	0.91	0.91	0.95
	a =	-0.183	-0.249	-0.153	-0.220	-0.215	-7.625
	b =	0.030	0.035	0.029	0.033	0.033	1.056
	n =	20	21	21	21	21	11

Excellent results were found with the correlations of the Saltair station evaporation data and the South Arm and Farmington Bay night temperatures, as shown in Table 4. However, the monthly correlations, which are typically better because they approximate the long-term, were poorer than the short-term correlations. The Farmington Bay correlation was a modest 88%, but that for the South Arm was a low 74%. These monthly correlations were low and erratic, undoubtedly due to the small number of observations in the analysis, and therefore not valid. Correlations of the same-day, day-before, day-after and two and three-day pan evaporations with the South Arm temperature were very good, ranging from 95 to 99%. They were slightly higher than those for the Farmington Bay temperature which ranged from 95 to 97%.

The results of the correlations between the daily and monthly lake evaporations correlated and the South Arm and Farmington Bay temperatures were very similar to those involving the pan evaporations It is conceivable that reasonably accurate short-term evaporation estimates for the South part of the lake could be made using the model developed from the nighttime linear regression output.

Correlations of the North Arm, Bear River Bay and Willard Bay nighttime temperatures with the Bear River Refuge pan were dissapointingly low with no apparent reason as shown in Table 5. The North Arm fared the worst with correlation coefficients ranging from 40 to 72% and the Willard Bay was the best with a range of 64 to 96%. It is interesting to note that the best single-day correlations were found with the day-after evaporation instead of with the day-before evaporation as was the case with all of the previously presented correlations.

As with the correlations of the night temperatures and evaporations from the South part of the lake, the correlations of the northern nighttime surface

TABLE 4

Correlation and Linear Regression Results for Great Salt Lake South Area Satellite Night Temperatures versus Saltair Evaporations

Temperature Area		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
South Arm	r =	0.99	0.95	0.97	0.98	0.98	0.74
	a =	-1.072	-1.238	-0.940	-1.146	-1.090	-24.087
	b =	0.115	0.126	0.104	0.120	0.115	2.986
	n =	6	6	6	6	6	3
Farmington Bay	r =	0.95	0.96	0.96	0.96	0.97	0.88
	a =	-0.921	-1.151	-0.850	-1.025	-0.978	-27.731
	b =	0.111	0.127	0.103	0.118	0.114	3.392
	n =	6	6	6	6	6	3
				Lake Evaporations			
South Arm	r =	0.99	0.95	0.97	0.98	0.98	0.72
	a =	-0.702	-0.790	-0.608	-0.735	-0.705	-15.091
	b =	0.075	0.081	0.067	0.077	0.074	1.905
	n =	6	6	6	6	6	3
Farmington Bay	r =	0.95	0.96	0.96	0.96	0.97	0.90
	a =	-0.629	-0.785	-0.592	-0.697	-0.668	-19.334
	b =	0.075	0.085	0.071	0.080	0.077	2.309
	n =	6	6	6	6	6	3

TABLE 5

Correlation and Linear Regression Results for Great Salt Lake North Area Satellite Night Temperatures versus Bear River Refuge Evaporations

Temperature Area		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
North Arm	r =	0.49	0.40	0.66	0.72	0.69	ID[1]
	a =	−0.193	0.269	−0.813	0.044	−0.226	
	b =	0.033	0.025	0.074	0.029	0.043	
	n =	5	5	5	5	5	
Bear River Bay	r =	0.73	0.40	0.86	0.69	0.83	ID
	a =	−0.365	0.114	−0.824	−0.117	−0.342	
	b =	0.049	0.035	0.088	0.041	0.056	
	n =	5	5	5	5	5	
Willard Bay	r =	0.67	0.82	0.64	0.96	0.90	ID
	a =	−0.310	−0.415	−0.509	−0.356	−0.407	
	b =	0.046	0.073	0.067	0.059	0.061	
	n =	5	5	5	5	5	
				Lake Evaporations			
North Arm	r =	0.50	0.39	0.65	0.72	0.68	ID
	a =	−0.119	0.159	−0.466	0.032	−0.133	
	b =	1.964	0.014	0.043	0.016	0.025	
	n =	5	5	5	5	5	
Bear River Bay	r =	0.73	0.40	0.86	0.69	0.84	ID
	a =	−0.248	0.069	−0.557	−0.088	−0.246	
	b =	0.033	0.024	0.060	0.028	0.039	
	n =	5	5	5	5	5	

[1] ID indicates insufficient data.

temperatures with the equivalent lake evaporation were similar to those with the Bear River Refuge pan evaporations. Similar to the daytime temperatures versus lake evaporations (Table 2), the Willard Bay temperature correlated best with its equivalent lake evaporation.

Table 6 presents the correlation results for the Whole-lake satellite night temperatures versus regional pan and lake evaporations. The day-before and day-after pan correlations were 94 and 95% respectively while that for the same-day was a lower 86%. The two and three-day averages were a very good 93 and 97%, but the monthly was again lower at 83% due to insufficient data. The Whole-lake surface temperatures correlated equally well with the pan and lake evaporations, but the linear regression output describes two different sets of lines. These linear regression results for the three-day average or even the day-before or day-after correlations could be used, with some confidence, in estimating evaporation from the whole lake.

Therefore, night thermal data can most likely be used to estimate short-term evaporation for the south sections and whole lake and possibly for the north sections. However, due to lack of data, it is not certain how well monthly evaporation estimates can be made. The availability of night data would be the only drawback in using these night temperatures in the relationships developed. HCMM has been decommissioned, but Landsat V can provide night temperatures, but only by special request, and under the provision that the requestor will purchase the data, regardless of its quality.

TABLE 6

Correlation and Linear Regression Results for Great Salt Lake Unweighted Whole Lake Satellite Night Temperatures versus Regional Evaporations

Temperature Area		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
				Pan Evaporations			
Whole Lake	r =	0.86	0.94	0.95	0.93	0.97	0.83
	a =	-0.754	-0.634	-0.611	-0.711	-0.815	-14.004
	b =	0.086	0.082	0.076	0.085	0.090	2.126
	n =	6	6	6	6	6	3
				Lake Evaporations			
Whole Lake	r =	0.86	0.95	0.95	0.93	0.97	0.83
	a =	-0.475	-0.410	-0.409	-0.449	-0.518	-8.890
	b =	0.054	0.052	0.048	0.053	0.057	1.341
	n =	6	6	6	6	6	3

TEMPERATURE-SALT RATIOS

The tables of correlation results discussed thus far have involved pan data and lake data determined by multiplying pan data by pan and salt coefficients. Another approach at accounting for the salinity effects on the evaporation from the lake was to divide the satellite surface temperature by the salinity. These ratios were calculated for all temperature data and then correlated with Saltair and Bear River Refuge pan evaporations for 1978, 1979, 1978 and 1979, and 1978 through 1986 (all data). The results of these correlations are shown in Table 7. The South Arm temperatures and salinities versus the Saltair pan were first investigated and found to have poor correlations, averaging 43% when all of the data from 1978 to 1986 were used. But when only data for the individual years were used, the correlations improved considerably to 87% for 1978 and 90% for 1979. Combining 1978 and 1979 and performing the correlations gave a slightly lower coefficient of 83%. From 1979 to 1986 the South Arm salinity dropped from 14.8% to 4.8% causing the temperature/salinity ratios to soar out of proportion with those from 1978 and 1979. This explains the poor correlations when all the data from 1978 to 1986 were used.

The exact opposite was found to be true with the results of the North Arm temperature and salinities versus the Bear River Refuge pan. Table 8 shows that the correlations for the ratio of the North Arm temperature divided by the North Arm salinity versus the Bear River Refuge pan considering all of the data (1978-1986) were among the best ranging from 71 to 90% and an average of 80%. However, the yearly results were quite erratic, showing no consistent trends. The short-term correlation coefficients ranged from 21 to 99% with an average of 69%, however those for the long-term correlations were much better at 90 and 91%.

TABLE 7

Correlation and Linear Regression Result for the Ratios of Great Salt Lake South Arm Satellite Temperature over Percent Salt Content versus Saltair Pan Evaporations

Data		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
1978	r =	0.82	0.83	0.90	0.86	0.86	0.96
	a =	-0.443	-0.542	-0.473	-0.547	-0.515	-20.074
	b =	0.855	0.934	0.821	0.948	0.918	32.126
	n =	13	12	11	13	13	6
1979	r =	0.91	0.89	0.85	0.90	0.91	0.94
	a =	-0.224	-0.074	0.075	-0.143	-0.074	2.717
	b =	0.846	0.743	0.555	0.790	0.714	18.833
	n =	8	8	8	8	8	4
1978 & 1979	r =	0.82	0.79	0.81	0.83	0.84	0.89
	a =	-0.256	-0.241	-0.137	-0.285	-0.246	-6.367
	b =	0.785	0.778	0.638	0.814	0.773	23.832
	n =	21	20	19	21	21	10
All Data	r =	0.34	0.50	0.52	0.37	0.38	0.47
(1978-1986)	a =	0.605	0.462	0.467	0.608	0.603	15.350
	b =	0.123	0.228	0.173	0.131	0.126	7.597
	n =	24	22	21	24	24	11

TABLE 8

Correlation and Linear Regression Results for the Ratios of Great Salt Lake North Arm Satellite Temperature over Percent Salt Content versus Bear River Refuge Pan Evaporations

Data		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
1978	r =	0.61	0.85	0.64	0.77	0.77	0.91
	a =	-0.431	-0.446	-0.337	-0.214	-0.187	-8.269
	b =	1.213	1.527	1.192	1.076	1.033	34.246
	n =	19	12	10	12	12	5
1979	r =	0.99	0.42	0.21	0.76	0.55	ID
	a =	-2.119	1.741	-0.259	-1.385	-1.034	
	b =	3.494	-1.314	1.178	2.737	2.246	
	n =	3	4	4	4	4	
1978 & 1979	r =	0.63	0.78	0.53	0.75	0.72	0.90
	a =	-0.490	-0.383	-0.331	-0.267	-0.227	-11.550
	b =	1.295	1.439	1.210	1.188	1.120	40.004
	n =	12	16	14	16	16	7
All Data (1978-1986)	r =	0.83	0.75	0.71	0.81	0.81	0.90
	a =	-0.200	0.068	0.031	0.009	0.016	-11.550
	b =	0.896	0.784	0.719	0.787	0.767	40.004
	n =	14	18	15	18	17	7

SALT TEMPERATURES

Because of the high variability of the temperature/salinity ratios, another attempt to adjust the water temperature with the salt concentration was made. A new 'salt temperature' was calculated by multiplying the surface temperature by the salt coefficient. This has the effect of lowering the lake temperature to match that of an equivalent body of fresh-water. One drawback to this and the previous ratio method is that salinity data must also be provided in addition to the temperature data as input to the evaporation estimation model.

Table 9 shows the results for the South Arm salt temperatures versus the Saltair pan evaporations. They are in near agreement with those r values found in Table 7 with the exception of the correlations considering all of the data from 1978 to 1986. The salt temperature results represent an improvement in the correlations during the low salt concentration years.

The same is true for the North Arm salt temperatures versus the Bear River Refuge pan evaporations as shown in Table 10. The r values are about the same or slightly worse than those for the ratios of the North Arm temperature divided by the North Arm salinity versus the Bear River Refuge pan (Table 8). It is evident that this method can cope with a high variability in the lake's salinity. Even so, its results are inconclusive making it uncertain whether or not a reliable model could be developed from it. More data should be investigated to verify this.

LAKE EVAPORATIONS FROM PAN EQUATIONS

Possibly the best approach to modeling lake evaporations would be to multiply the results from the equations developed to yield pan evaporations by the appropriate pan and salt coefficients. The pan coefficient was a constant 0.7 and the salt coefficients are given in Figure 5. Since the lake

TABLE 9

Correlation and Linear Regression Results for the Products of Great Salt Lake South Arm Satellite Temperatures Times Salt Coefficents versus Saltair Pan Evaporations

Data		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
1978	r =	0.79	0.81	0.88	0.84	0.83	0.92
	a =	−0.442	−0.586	−0.538	−0.585	−0.538	-19.887
	b =	0.074	0.082	0.073	0.083	0.079	2.771
	n =	13	12	11	13	13	6
1979	r =	0.89	0.87	0.80	0.88	0.88	0.90
	a =	−0.177	−0.036	+0.124	−0.101	−0.029	6.082
	b =	0.064	0.056	0.041	0.060	0.054	1.316
	n =	8	8	8	8	8	4
1978 & 1979	r =	0.81	0.79	0.80	0.83	0.82	0.85
	a =	−0.293	−0.281	−0.164	−0.326	−0.269	-4.083
	b =	0.067	0.067	0.054	0.070	0.066	1.872
	n =	21	20	19	21	21	10
All Data (1978-1986)	r =	0.76	0.79	0.78	0.78	0.77	0.85
	a =	−0.170	−0.206	−0.100	−0.178	−0.114	-4.134
	b =	0.058	0.062	0.051	0.059	0.055	1.874
	n =	24	22	21	24	24	11

TABLE 10

Correlation and Linear Regression Results for the Products of Great Salt Lake North Arm Satellite Temperatures Times Salt Coefficients versus Bear River Refuge Pan Evaporations

Data		Same Day	Day Before	Day After	2-Day Average	3-Day Average	Total Month
1978	r =	0.57	0.85	0.60	0.75	0.75	0.88
	a =	-0.391	-0.471	-0.298	-0.223	-0.190	-8.015
	b =	0.053	0.071	0.052	0.050	0.047	1.558
	n =	9	12	10	12	12	5
1979	r =	0.99	0.38	0.22	0.74	0.54	ID
	a =	-2.414	1.814	-0.471	-1.730	-1.340	
	b =	0.170	-0.062	0.064	0.141	0.117	
	n =	3	4	4	4	4	
1978 & 1979	r =	0.59	0.78	0.51	0.75	0.71	0.90
	a =	-0.751	-0.405	-0.316	-0.283	-0.236	-11.062
	b =	0.078	0.066	0.054	0.055	0.051	1.791
	n =	12	16	14	16	16	7
All Data (1978-1986)	r =	0.71	0.83	0.63	0.81	0.77	0.90
	a =	-0.963	-0.455	-0.438	-0.412	-0.314	-11.062
	b =	0.092	0.070	0.062	0.064	0.057	1.791
	n =	14	18	15	18	17	7

evaporation equations were developed largely from 1978 and 1979 data, they work very well when the salinity is near the 1978-79 levels. Table 11 demonstrates, with a few examples, how the pan equation values multiplied by the pan and salt coefficients compare very well with the lake equation values. These examples are for most lake areas, for different time periods, and for both day and night correlations.

Multiplying the results of the pan equation by the pan and salt coefficients offers the benefits of accounting for large variations in the lake's salinity and uses the best correlations found in this study. It does, however, have the disadvantage of requiring that salinity data along with the surface temperature data. Figure 10 shows an approximate relationship between the lake's elevation and the lake's salinity expressed as percent TDS by weight for both the North and South Arms. This might be used for salinity approximations when no other data is available.

MODEL EVAPORATION

Since there are inherent shortcomings with pan data, another approach to creating a temperature-evaporation relationship was to correlate surface temperatures with evaporations generated by a computer model. The model used was called WREVAP and developed by F.I. Morton (1985). It uses climatological data and characteristics of the water body studied as input but according to Morton needs no calibration. The Salt Lake City Airport Weather Station is the only station in the area that provides all of the data required to run the model. The model has the capability of routinely generating evaporation for periods of a month to about a week with good accuracy. With some manipulation, evaporation values representing the average of four days

Table 11

<u>Comparisons Between Evaporations from Pan Equations Times Pan and Salt Coefficients and Lake Equations</u>

South Arm Monthly Evaporation at Temperature = 20°C

$E_{pan} = -3.301 + 1.702(20) = 30.739$

$E'_{lake} = (30.739)(0.7)(0.93) = \underline{20.01\ cm}$

$E_{lake} = -1.793 + 1.092(20) = \underline{20.05\ cm}$

South Arm Two-Day Average Evaporation at Temperature = 20°C

$E_{pan} = -0.230 + 0.058(20) = 0.930$

$E'_{lake} = (0.930)(0.7)(0.93) = \underline{0.61\ cm}$

$E_{lake} = -0.162 + 0.039(20) = \underline{0.62\ cm}$

Farmington Bay Monthly Evaporation at Temperature = 20°C

$E_{pan} = -11.911 + 2.040(20) = 28.889$

$E'_{lake} = (28.889)(0.7)(0.96) = \underline{19.41\ cm}$

$E_{lake} = -8.174 + 1.381(20) = \underline{19.45\ cm}$

Farmington Bay Three-Day Average Evaporation at Temperature = 20°C

$E_{pan} = -0.226 + 0.056(20) = 0.894$

$E'_{lake} = (0.894)(0.7)(0.96) = \underline{0.60\ cm}$

$E_{lake} = -0.161 + 0.038(20) = \underline{0.60\ cm}$

North Arm Monthly Evaporation at Temperature = 20°C

$E_{pan} = -10.925 + 1.48\ (20) = 18.675$

$E'_{lake} = (18.675)(0.7)(0.83) = \underline{10.85\ cm}$

$E_{lake} = -6.284 + 0.854(20) = \underline{10.80\ cm}$

North Arm Day-Before Evaporation at Temperature = 20°C

$E_{pan} = -0.493 + 0.061(20) = 0.727$

$E'_{lake} = (0.727)(0.7)(0.83) = \underline{0.42\ cm}$

$E_{lake} = -0.314 + 0.037(20) = \underline{0.43\ cm}$

TABLE 11 cont.

Comparisons Between Evaporation from Pan Equations Times Pan & Salt Coefficients and Lake Equations

Bear River Bay Monthly Evaporation at Temperature = 20°C

$$E_{pan} = -10.819 + 1.416(20) = 17.501$$

$$E'_{lake} = (17.501)(0.7)(0.95) = \underline{11.64\ cm}$$

$$E_{lake} = -6.709 + 0.917(20) = \underline{11.63\ cm}$$

Bear River Bay Day-Before Average Evaporation at Temperature = 20°C

$$E_{pan} = -0.386 + 0.056(20) = 0.734$$

$$E'_{lake} = (0.734)(0.7)(0.95) = \underline{0.49\ cm}$$

$$E_{lake} = -0.266 + 0.038(20) = \underline{0.49\ cm}$$

Whole Lake Monthly Evaporation at Temperature = 20°C

$$E_{pan} = -9.061 + 1.610(20) = 23.139$$

$$E'_{lake} = (23.139)(0.7)(0.91) = \underline{14.74\ cm}$$

$$E_{lake} = -6.191 + 1.048(20) = \underline{14.77\ cm}$$

Whole Lake Two-Day Average Evaporation at Temperature = 20°C

$$E_{pan} = -0.343 + 0.053(20) = 0.717$$

$$E'_{lake} = (0.717)(0.7)(0.91) = \underline{0.46\ cm}$$

$$E_{lake} = -0.225 + 0.034(20 = \underline{0.46\ cm}$$

Whole Lake Three-Day Average Evaporation at Night Temperature = 15°C

$$E_{pan} = -0.815 + 0.090(15) = 0.535$$

$$E'_{lake} = (0.535)(0.7)(0.91) = \underline{0.34\ cm}$$

$$E_{lake} = -0.518 + 0.057(15) = \underline{0.34\ cm}$$

South Arm Three-Day Average Evaporation at Night Temperature = 15°C

$$E_{pan} = -1.090 + 0.115(15) = 0.635$$

$$E'_{lake} = (0.635)(0.7)(.93) = \underline{0.41\ cm}$$

$$E_{lake} = -0.705 + 0.074(15) = \underline{0.41\ cm}$$

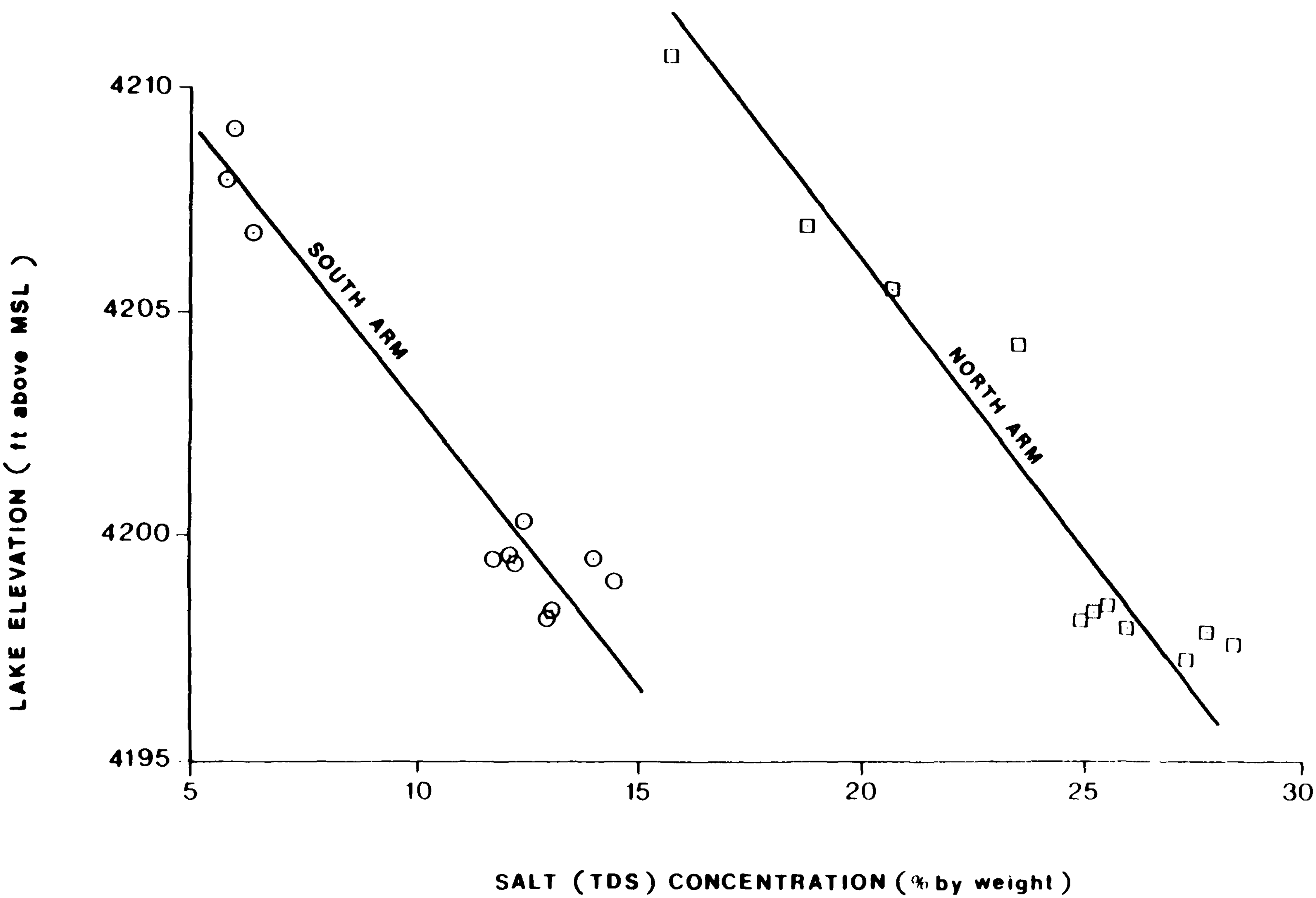


Figure 10. Salt Concentration of the North and South Arms of the Great Salt Lake Vs. Surface Elevation

were also determined. The model generates both pan and lake values and also factors in salinity and therefore pan evaporations were determined by entering zero for the salt content and the lake evaporations were determined by entering the appropriate salt content.

Model Evaporation Versus Temperature

The temperatures of the South Arm, Farmington Bay, Whole-Lake and South Lake were correlated with the model evaporations. Since the data used as input to the model were from the Salt Lake City Airport Weather Station, it did not seem reasonable to correlate the model evaporations with the North Arm, Bear River Bay or Willard Bay areas.

Farmington Bay, being closest to the Airport Weather Station would be expected to correlate best with the model evaporations and this was the case as shown in Table 12. The monthly model pan evaporation versus Farmington Bay temperature correlated with a coefficient of 97% and the monthly model lake evaporation versus the Farmington Bay temperature with 96%. The correlation of 91% for the four-day model pan average was somewhat lower than that for the monthly, possibly due to the day-to-day variability of the climate, but was still better than the three-day average Saltair pan or lake evaporation versus the same Farmington Bay temperature (Table 1). Another possible reason for the lower four-day correlation may be due to extending the model to uses that it really was not designed for. Morton says that evaporation averages for periods of three days or less can be obtained but their accuracy is questionable. The South Arm temperature also correlated well with the model pan and lake evaporations, the correlation coefficients being only 2% lower than their Farmington Bay counterparts.

TABLE 12

Correlation and Linear Regression Results for Great Salt Lake Satellite Temperatures versus Model Evaporations[1]

Temperature Area		4-Day Avg. Evap. Pan	4-Day Avg. Evap. Lake	Total Month Evap. Pan	Total Month Evap. Lake
South Arm	r =	0.89	0.87	0.95	0.94
	a =	-0.184	-0.071	-3.337	-1.327
	b =	0.058	0.029	1.657	0.888
	n =	27	27	13	12
Farmington Bay	r =	0.91	0.89	0.97	0.96
	a =	-0.147	-0.062	-1.680	0.165
	b =	0.054	0.029	1.438	0.781
	n =	25	25	11	10
Unweighted Whole Lake	r =	0.90	0.87	0.96	0.94
	a =	-0.145	-0.042	-1.779	0.539
	b =	0.054	0.026	1.491	0.733
	n =	28	28	13	12
Weighted Whole Lake	r =	0.90	0.87	0.96	0.93
	a =	0.160	-0.049	-1.987	0.204
	b =	0.055	0.027	1.488	0.762
	n =	28	28	12	12
Unweighted South Lake	r =	0.90	0.88	0.96	0.93
	a =	-0.155	-0.060	-2.647	0.153
	b =	0.056	0.028	1.574	0.809
	n =	27	27	13	12
Weighted South Lake	r =	0.90	0.88	0.95	0.93
	a =	-0.164	-0.065	-2.896	0.074
	b =	0.050	0.029	1.605	0.822
	n =	27	27	13	12

[1]Model evaporations are generated by the F.I. Morton Model using Salt Lake Airport meteorological data.

Combining the two southern areas to get the South Lake average temperature and correlating with the model evaporations, yielded correlation coefficients that were comparable to those for the Farmington Bay and South Arm correlations (Table 12). This was true for both the monthly and four-day correlations. The monthly and four-day weighted South Lake correlations were the same or only slightly lower than those for the unweighted temperatures.

The unweighted and weighted Whole-lake temperatures were correlated with the model evaporations in order to determine whether or not a Whole-lake temperature-evaporation model could be developed in this manner. There is a known climate difference between the north and south portions of the lake that may have prevented the development of a model, since the northern portions of the lake are so far removed from the Airport Weather station. The monthly model pan evaporation correlated very well with the Whole-lake temperature with r values of 96% for the modeled pan evaporations and 94% for the modeled lake evaporations. The four-day model pan and lake correlation coefficients were, respectively, 90% and 87%. Using weighted and unweighted temperature averages made no difference whatsoever.

From the results it appears that a reliable model has been developed that can estimate evaporation from the whole lake on a monthly basis comparable to the model evaporation using only the surface temperature of the lake as input. Further investigation would determine its full potential as well as the ability to estimate evaporation for shorter periods of time.

Model Evaporation Versus Measured Evaporation

Since the results of correlations of surface temperatures with pan evaporation data were lower than those with the model evaporations, the model evaporation was correlated with the pan evaporation to see how the two

compared. Table 13 for the lake's south areas shows that they compared very well, especially with the monthly evaporations. The a and b values from the linear regression output indicate the similarity of the two data sets. When b is very close to one, and a is very close to zero then corresponding numbers from each data set should be approximately equal. If b is not equal to one, but the correlation coefficient is high and a is near zero, then the corresponding numbers in the data sets differ approximately by a constant factor equalling the absolute value of b.

The correlations for the Saltair pan versus the model evaporation showed high correlation coefficients, b values near one and a values near zero. This means that there is nearly a one to one relationship between the Saltair pan and the model evaporations generated from the Salt Lake City Airport Weather Station climatological data. This would be expected.

When the equivalent lake evaporations for the South Arm and Farmington Bay were correlated with the model evaporations, the correlations remained high, but the b values jumped to an average of 1.2. This means that the equivalent lake evaporation values, which were assigned to the Y-axis, were, on the average, 1.2 times greater than the model evaporations, which were assigned to the X-axis. This suggests that the salt coefficients and/or the pan coefficients used in the model were lower than those used in our method. It would be left to the discretion of the user as to which salt and pan coefficients to use.

Table 14 shows that there was also a very strong correlation between the model evaporations and the regional evaporations, especially for the monthly values. The correlations with the regional pan average were slightly better than those for the two sets of sectional lake evaporations. However, the a and b values indicate that the temperature-evaporation relationship for the

TABLE 13

Correlation and Linear Regression Results for South Area Pan and Lake Measured Evaporations versus Model Evaporations

Location		4-Day Avg. Model Evap. vs. 2-Day Avg. Meas. Evap.	4-Day Avg. Model Evap. vs. 3-Day Avg. Meas. Evap.	Total Month Model Evap. vs. Total Month Meas. Evap.
Saltair Pan	r =	0.91	0.91	0.98
Evaporation	a =	-0.027	-0.011	0.003
(zero salt)	b =	1.002	0.941	1.026
	n =	24	24	10
South Arm	r =	0.87	0.89	0.96
Lake Evap.	a =	-0.009	0.002	-0.396
(w/SA salt	b =	1.210	1.165	1.230
coefficients)	n =	24	24	10
Farmington Bay	r =	0.88	0.90	0.96
Lake Evap.	a =	-0.016	-0.004	-0.321
(w/FB salt	b =	1.220	1.172	1.215
coefficients)	n =	24	24	10

TABLE 14

Correlation and Linear Regression Results for Regional Pan and Lake Measured Evaporations versus Model Evaporations

Location		4-Day Avg. Model Evap. vs. 2-Day Avg. Meas. Evap.	4-Day Avg. Model Evap. vs. 3-Day Avg. Meas. Evap.	Total Month Model Evap. vs. Total Month Meas. Evap.
Regional Pan	r =	0.93	0.93	0.99
Evaporation	a =	-0.008	0.007	0.246
(zero salt)	b =	0.767	0.773	0.802
	n =	23	22	9
Whole Lake	r =	0.90	0.92	0.96
Evaporation	a =	-0.003	-0.016	0.822
(w/WL salt	b =	0.934	0.983	0.905
coefficients)	n =	23	22	9
South Lake	r =	0.89	0.91	0.96
Evaporation	a =	0.010	-0.011	0.836
(w/SL salt	b =	0.907	0.973	0.904
coefficients)	b =	23	22	9

Whole-lake and South Lake evaporations had more nearly a one-to-one relationship with the model evaporations than did the regional pan. Table 13 shows the opposite to be true, the pan evaporations being more nearly a one-to-one relationship than the lake evaporations.

CONCLUSIONS

Several approaches were taken in trying to produce a reliable model to estimate evaporation from the Great Salt Lake using remote sensing techniques. Each of these approaches involved correlating evaporation values with the lake's surface temperature by performing a linear regression to get an equation, or model, that defines the evaporation for a given surface temperature. Some of the approaches were successful, producing models that should be reliable, while others were not. It seems that possibly the best approach to modeling the evaporation from the Great Salt Lake would be to multiply the equations developed to model pan evaporations by the appropriate salt and pan coefficients.

Most of the correlations which were successful provided monthly evaporation estimates from monthly data. For example, the best estimates of monthly evaporation from the whole lake would be expressed by the equation in Table 3a for the correlation of the Whole-lake temperature with the regional average pan evaporation:

$$E\ (\text{cm}) = (-9.061 + 1.610 \cdot T\ (^{\circ}\text{C})) \cdot 0.7 \cdot C_s \quad (r=0.91)$$

where C_s is the corresponding salt coefficient.

Evaporation estimates for the Whole-lake for shorter periods of time could be made with slightly less accuracy. An equation which would yield fairly good estimates averaged for a two-day period is the result of the correlation

of unweighted whole-lake temperature and the regional pan evaporations also found in Table 3a:

$$E\ (\mathrm{cm}) = (-0.343 + 0.053 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.91)$$

There were also other correlations that provided very good results and could be used for the whole lake and also for smaller areas of the lake. The monthly evaporation from the South Arm could be estimated by the equation in Table 1:

$$E\ (\mathrm{cm}) = (-3.301 + 1.702 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.95)$$

and the three-day average evaporation could be estimated using the nighttime temperature in the equation found in Table 4:

$$E\ (\mathrm{cm}) = (-1.090 + 0.115\ .\ T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.98)$$

or the daytime temperature could be used to get the two-day average evaporation using the equation in Table 1:

$$E\ (\mathrm{cm}) = (-0.230 + 0.058\ .\ T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.80)$$

The monthly evaporation from Farmington Bay is represented by the equation in Table 1:

$$E\ (\mathrm{cm}) = (-11.911 + 2.040 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.92)$$

and the three-day average evaporation can be determined by the equation in Table 4 using the nighttime temperature:

$$E\ (\mathrm{cm}) = (-0.978 + 0.114 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.97)$$

Evaporation from the combined South Arm and Farmington Bay (South Lake) can be modeled on a monthly or short-term basis. The monthly evaporation can be determined using the equation in Table 3a:

$$E\ (\mathrm{cm}) = (-9.303 + 1.634 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.92)$$

and the three-day evaporation average equation can also be found in Table 3a:

$$E\ (\mathrm{cm}) = (-0.342 + 0.054 \cdot T\ (^{\circ}\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.91)$$

Evaporation models from the northern areas of the lake were also developed with success. The monthly evaporation from Bear River Bay is represented by the equation in Table 2:

$$E\ (\mathrm{cm}) = (-10.819 + 1.416 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.97)$$

and an evaporation equation for the day before the satellite passed over is:

$$E\ (\mathrm{cm}) = (-0.386 + 0.056 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.85)$$

The monthly evaporation from the North Arm is represented by the equation in Table 2:

$$E\ (\mathrm{cm}) = (-10.925 + 1.480 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot Cs \quad (r=0.90)$$

and the day-before evaporation can also be obtained from Table 2:

$$E\ (\mathrm{cm}) = (-0.493 + 0.061 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.80)$$

Evaporation from both the North Arm and Bear River Bay (North Lake) can be estimated on a monthly basis using the daytime temperature in the Table 3a equation:

$$E\ (\mathrm{cm}) = (-11.794 + 1.695 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.97)$$

and the day-before evaporation can be estimated by (Table 3a):

$$E\ (\mathrm{cm}) = (-0.400 + 0.057 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \cdot C_s \quad (r=0.91)$$

Willard Bay's evaporation can be approximated on a monthly basis using the equation in Table 2:

$$E\ (\mathrm{cm}) = (-10.406 + 1.482 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \quad (r=0.93)$$

and for the day before using (Table 2):

$$E\ (\mathrm{cm}) = (-0.531 + 0.065 \cdot T\ (^\circ\mathrm{C})) \cdot 0.7 \quad (r=0.83)$$

These results indicate that models can be developed to estimate evaporation from the entire lake and from smaller sections of it while taking into account the salinity of the lake. Accounting for the effects of salinity is something that had not been investigated in previous studies and further research would help us better understand how to best deal with the salt.

CONTINUED STUDY

One topic of emphasis in a continued study would be to photo-scan photographs of thermal satellite imagery and digitize them to obtain surface temperatures. This would cut both cost and time spent determining the surface temperatures significantly and more recent data would be available.

Another topic would be to study the effects of atmospheric moisture, atmospheric pressure and wind on this method. Until now these factors have been assumed to be constant or their effects negligible.

The West Desert Pond, being formed by pumping water from the Great Salt Lake, was designed to evaporate water from the North Arm of the Great Salt Lake. Its evaporation is currently being monitored by Eckoff, Watson and Preator, a local consulting firm. It would be valuable to model the evaporation from the West Pond using satellite imagery and compare the results with those found by Eckoff, Watson and Preator. Evaporation data used to calibrate the temperature-evaporation model could be obtained from Morton's Model or a traditional evaporation equation, e.g. Penman's equation. There are several temporary meteorological data stations around the West Desert Pond which could provide data for the evaporation model.

APPENDIX A1

Saltair Pan Evaporation (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	1.02	0.76	-	0.89	1.02	24.31
14 June 78	-	-	-	-	-	31.67
6 July 78	1.14	1.14	0.99	1.14	1.09	38.23
27 July 78	1.14	1.22	-	1.18	1.25	
2 Aug. 78	1.14	-	1.04	1.37	1.26	33.25
7 Aug. 78	1.09	1.09	1.14	1.09	1.11	
23 Aug. 78	1.37	1.45	1.14	1.41	1.32	
28 Aug. 78	1.02	0.86	0.76	0.94	0.88	
13 Sept. 78	0.46	0.41	0.43	0.44	0.43	20.22
23 Sept. 78	0.51	0.46	0.46	0.48	0.48	
9 Oct. 78	0.43	0.43	0.38	0.43	0.41	12.34
14 Oct. 78	0.43	0.58	0.43	0.50	0.48	
25 Oct. 78	0.38	0.38	0.38	0.38	0.38	
26 Oct. 78	0.38	0.38	0.38	0.38	0.38	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	0.64	0.64	0.76	0.64	0.68	18.54
14 July 79	1.14	1.14	1.02	1.14	1.10	36.70
9 Aug. 79	0.76	1.14	0.91	0.95	0.94	28.52
25 Aug. 79	0.96	0.91	0.81	0.93	0.89	
4 Sept. 79	1.02	1.14	0.91	1.08	1.02	26.92
11 Sept. 79	1.14	1.14	0.71	1.14	1.00	
16 Sept. 79	0.76	0.76	0.76	0.76	0.76	
21 Sept. 79	0.89	0.86	0.94	0.88	0.90	
2 Nov. 79	0.03	0.18	0.18	0.11	0.13	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.46	0.81	0.94	0.64	0.74	25.40
27 July 84	0.99	1.09	-	1.04	0.94	-
15 June 86	1.14	1.14	1.32	1.14	1.20	33.78
2 Aug. 86	0.94	-	0.94	0.89	0.91	

APPENDIX A2

Saltair Pan Evaporation X South Arm Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.96	0.71	-	0.83	0.96	22.80
14 June 78	-	-	-	-	-	29.64
6 July 78	1.07	1.07	0.93	1.07	1.02	35.71
27 July 78	1.06	1.14	-	1.10	1.17	
2 Aug 78	1.06	-	0.97	1.28	1.18	30.99
7 Aug 78	1.02	1.02	1.06	1.02	1.03	
23 Aug 78	1.28	1.35	1.06	1.31	1.23	
28 Aug 78	0.95	0.80	0.71	0.88	0.82	
13 Sept 78	0.43	0.38	0.40	0.41	0.40	18.80
23 Sept 78	0.47	0.43	0.43	0.45	0.45	
9 Oct 78	0.40	0.40	0.35	0.40	0.38	11.44
14 Oct 78	0.40	0.54	0.40	0.46	0.45	
25 Oct 78	0.35	0.35	0.35	0.35	0.35	
26 Oct 78	0.35	0.35	0.35	0.35	0.35	
26 Nov 78	-	-	-	-	-	-
24 Mar 79	-	-	-	-	-	-
15 Apr 79	0.60	0.60	0.71	0.60	0.64	17.35
14 July 79	1.06	1.06	0.94	1.06	1.02	33.98
9 Aug 79	0.70	1.05	0.84	0.88	0.87	26.32
25 Aug 79	0.89	0.84	0.75	0.86	0.82	
4 Sept 79	0.94	1.05	0.84	0.99	0.94	24.77
11 Sept 79	1.05	1.05	0.65	1.05	0.92	
16 Sept 79	0.70	0.70	0.70	0.70	0.70	
21 Sept 79	0.82	0.79	0.86	0.81	0.83	
2 Nov 79	0.03	0.16	0.16	0.10	0.12	-
14 Nov 79	-	-	-	-	-	
9 June 84	0.45	0.79	0.92	0.62	0.72	24.79
27 July 84	0.77	1.06	-	1.02	0.92	-
15 June 86	-	-	-	-	-	-
2 Aug 86	0.92	-	0.92	0.87	0.89	-

APPENDIX A3

Saltair Pan Evaporation X Farmington Bay Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.99	0.74	-	0.86	0.99	23.58
14 June 78	-	-	-	-	-	30.53
6 July 78	1.10	1.10	0.95	1.10	1.05	36.66
27 July 78	1.09	1.17	1.34	1.13	1.19	
2 Aug 78	1.09	1.53	0.99	1.31	1.20	31.62
7 Aug 78	1.04	1.04	1.09	1.04	1.06	
23 Aug 78	1.30	1.38	1.08	1.34	1.25	
28 Aug 78	0.97	0.81	0.72	0.89	0.83	
13 Sept 78	0.43	0.39	0.41	0.41	0.41	19.03
23 Sept 78	0.48	0.43	0.43	0.45	0.45	
9 Oct 78	0.40	0.40	0.36	0.40	0.38	11.53
14 Oct 78	0.40	0.54	0.40	0.47	0.45	
25 Oct 78	0.35	0.35	0.35	0.35	0.35	
26 Oct 78	0.35	0.35	0.35	0.35	0.35	
26 Nov 78	-	-	-	-	-	-
24 Mar 79	-	-	-	-	-	-
15 Apr 79	0.63	0.63	0.75	0.63	0.67	18.28
14 July 79	1.11	1.11	0.99	1.11	1.07	35.64
9 Aug 79	0.73	1.10	0.88	0.92	0.91	27.52
25 Aug 79	0.93	0.88	0.78	0.90	0.86	
4 Sept 79	0.98	1.10	0.88	1.04	0.98	25.84
11 Sept 79	1.10	1.10	0.68	1.10	0.96	
16 Sept 79	0.73	0.73	0.73	0.73	0.73	
21 Sept 79	0.85	0.82	0.70	0.84	0.86	
2 Nov 79	0.03	0.17	0.17	0.10	0.12	-
14 Nov 79	-	-	-	-	-	
9 June 84	0.45	0.79	0.92	0.63	0.73	24.89
27 July 84	0.97	1.07	0.73	1.02	0.92	28.63
15 June 86	1.12	1.12	1.29	1.12	1.18	33.10
2 Aug 86	0.92	0.82	0.92	0.87	0.89	28.87

APPENDIX A4

Bear River Refuge Pan Evaporation (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.71	0.53	0.86	0.62	0.70	16.48
14 June 78	0.71	0.86	0.79	0.79	0.79	20.40
6 July 78	0.46	0.56	0.97	0.51	0.66	
27 July 78	-	1.27	0.99	0.91	0.94	
2 Aug. 78	0.91	0.79	1.02	0.85	0.91	21.06
7 Aug. 78	0.61	0.79	0.76	0.70	0.72	
23 Aug. 78	0.79	0.99	0.58	0.89	0.79	
28 Aug. 78	0.43	0.69	0.36	0.56	0.49	
13 Sept. 78	0.13	0.18	0.36	0.15	0.23	11.61
23 Sept. 78	0.38	0.56	0.28	0.48	0.41	
9 Oct. 78	0.25	0.58	0.36	0.41	0.40	8.28
14 Oct. 78	0.05	0.41	0.23	0.23	0.23	
25 Oct. 78	-	0.20	-	0.33	0.33	
26 Oct. 78	-	0.38	-	0.38	0.38	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	0.43	-	0.51	0.43	0.47	12.14
14 July 79	-	0.69	0.94	1.03	1.00	25.25
9 Aug. 79	0.51	0.48	0.13	0.50	0.37	20.09
25 Aug. 79	0.66	0.81	0.71	0.74	0.73	
4 Sept. 79	0.38	0.66	0.43	0.52	0.49	-
11 Sept. 79	-	-	-	-	-	
16 Sept. 79	-	-	-	-	-	
21 Sept. 79	0.30	0.94	0.81	0.62	0.68	
2 Nov. 79	-	-	-	-	-	-
14 Nov. 79	-	-	-	-	-	-
9 June 84	0.64	0.31	0.43	0.48	0.46	23.72
27 July 84	0.74	1.09	0.94	0.92	0.92	28.91
15 June 86	1.12	1.14	-	1.13	-	-
2 Aug. 85	1.14	1.09	1.07	1.11	1.10	-

APPENDIX A5

Bear River Refuge Pan Evaporation x North Arm Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.69	0.51	0.83	0.60	0.68	15.99
14 June 78	0.68	0.23	0.76	0.76	0.76	19.65
6 July 78	0.44	0.54	0.93	0.49	0.63	-
27 July 78	-	1.21	0.94	0.86	0.90	
2 Aug. 78	0.87	0.75	0.97	0.81	0.87	19.99
7 Aug. 78	0.58	0.75	0.72	0.67	0.68	
23 Aug. 78	0.75	0.94	0.55	0.84	0.75	
28 Aug. 78	0.41	0.65	0.34	0.53	0.46	
13 Sept. 78	0.13	0.18	0.36	0.15	0.23	11.61
23 Sept. 78	0.38	0.56	0.28	0.48	0.41	
9 Oct. 78	0.23	0.54	0.34	0.38	0.31	7.73
14 Oct. 78	0.05	0.38	0.21	0.21	0.21	
25 Oct. 78	-	0.19	-	0.31	0.31	
26 Oct. 78	-	0.35	-	0.35	0.35	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	0.42	-	0.50	0.42	0.46	-
24 July 79	-	0.64	0.88	0.96	0.93	23.56
9 Aug. 79	0.47	0.44	0.12	0.46	0.34	18.48
25 Aug. 79	0.61	0.75	0.65	0.68	0.67	
4 Sept. 79	0.35	0.61	0.40	0.48	0.45	
11 Sept. 79	-	-	-	-	-	-
16 Sept. 79	-	-	-	-	-	
21 Sept. 79	0.29	0.90	0.77	0.59	0.65	
2 Nov. 79	-	-	-	-	-	-
14 Nov. 79	-	-	-	-	-	-
9 June 84	-	-	-	-	-	-
27 July 84	-	-	-	-	-	-
15 June 86	1.11	1.13	-	1.12	-	-
2 Aug. 86	1.13	1.08	1.06	1.10	1.09	-

APPENDIX A6

Bear River Refuge Pan Evaporation x Bear River Bay Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.59	0.44	0.72	0.52	0.58	13.76
14 June 78	0.59	0.72	0.66	0.66	0.66	17.01
6 July 78	0.38	0.47	0.81	0.42	0.55	18.98
27 July 78	-	1.06	0.82	0.76	0.78	
2 Aug. 78	0.76	0.66	0.85	0.71	0.76	17.50
7 Aug. 78	0.51	0.66	0.63	0.58	0.60	
23 Aug. 78	0.66	0.82	0.48	0.74	0.66	
28 Aug. 78	0.36	0.57	0.30	0.46	0.41	
13 Sept. 79	0.11	0.15	0.30	0.12	0.19	9.61
23 Sept. 79	0.31	0.46	0.23	0.40	0.34	
9 Oct. 79	0.21	0.48	0.30	0.34	0.33	6.85
14 Oct. 79	0.04	0.34	0.19	0.19	0.19	
25 Oct. 79	-	0.17	-	0.27	0.27	
26 Oct. 79	-	0.31	-	0.31	0.31	
26 Nov. 79	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	0.36	-	0.43	0.36	0.39	-
14 July 79	-	0.57	0.78	0.85	0.83	20.88
9 Aug. 79	0.42	0.40	-	0.41	-	16.55
25 Aug. 79	0.54	0.67	0.58	0.61	0.60	-
4 Sept. 79	0.31	0.54	0.35	0.43	0.40	-
11 Sept. 79	-	-	-	-	-	-
16 Sept. 79	-	-	-	-	-	-
21 Sept. 79	0.25	0.77	0.67	0.51	0.56	
2 Nov. 79	-	-	-	-	-	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.55	0.27	0.37	0.41	0.40	20.49
27 July 84	0.65	0.95	0.82	0.80	0.80	25.24
15 June 86	1.01	1.03	-	1.02	-	32.01
2 Aug. 86	1.04	0.99	0.98	1.01	1.0	29.07

APPENDIX A7

Regional Average Pan Evaporation (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.76	0.60	0.89	0.68	0.75	18.80
14 June 78	1.02	1.06	-	1.03	-	25.27
6 July 78	0.76	0.77	0.93	0.81	0.84	
27 July 78	0.95	1.14	1.12	1.04	1.07	30.0
2 Aug. 78	1.06	0.99	1.00	1.03	1.02	25.74
7 Aug. 78	0.89	0.97	0.93	0.93	0.93	
23 Aug. 78	0.96	-	0.76	-	0.95	
28 Aug. 78	0.76	0.86	0.61	0.81	0.74	
13 Sept. 78	0.32	0.28	0.34	0.30	0.31	16.86
23 Sept. 78	0.50	0.42	0.46	0.46	0.46	
9 Oct. 78	0.36	0.50	0.37	0.43	0.41	10.61
14 Oct. 78	-	0.44	0.35	0.35	0.35	
25 Oct. 78	0.35	0.25	0.38	0.30	0.30	
26 Oct. 78	0.38	0.19	0.38	0.32	0.32	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	-	-	-	-	-	-
14 July 79	-	0.86	0.92	0.86	0.96	28.93
9 Aug. 79	0.64	0.92	0.55	0.78	0.71	22.88
25 Aug. 79	0.65	0.71	0.73	0.68	0.69	
4 Sept. 79	0.67	0.92	0.68	0.80	0.76	21.51
11 Sept. 79	0.67	0.95	0.68	0.81	0.77	
16 Sept. 79	0.58	0.68	0.70	0.63	0.66	
21 Sept. 79	0.58	0.70	0.67	0.64	0.65	
2 Nov. 79	0.03	0.18	0.18	0.11	0.13	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.39	0.45	0.49	0.42	0.44	20.85
27 July 84	0.78	0.86	-	0.82	-	-
15 June 86	0.95	1.02	1.11	0.99	1.03	29.43
2 Aug. 86	1.00	0.83	0.92	0.92	0.92	27.31

APPENDIX A8

Regional Average Pan Evaporation x Whole Lake Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.69	0.55	0.81	0.62	0.68	17.16
14 June	0.93	0.96	-	0.94	-	22.95
6 July 78	0.69	0.70	0.84	0.73	0.76	27.15
27 July 78	0.86	1.03	1.01	0.94	0.97	
2 Aug. 78	0.96	0.89	0.90	0.93	0.92	23.19
7 Aug. 78	0.80	0.87	0.84	0.84	0.84	
23 Aug. 78	0.86	-	0.68	-	0.86	
28 Aug. 78	0.68	0.77	0.55	0.73	0.67	
13 Sept. 78	0.29	0.25	0.30	0.27	0.28	15.09
23 Sept. 78	0.45	0.38	0.41	0.41	0.41	
9 Oct. 78	0.32	0.45	0.33	0.38	0.37	9.46
14 Oct. 78	-	0.39	0.31	0.31	0.31	
25 Oct. 78	0.31	0.22	0.34	0.27	0.27	
26 Oct. 78	0.34	0.17	0.34	0.29	0.29	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	-	-	-	-	-	-
14 July 78	-	0.77	0.83	0.77	0.86	26.01
9 Aug. 79	0.57	0.82	0.47	0.70	0.63	20.41
25 Aug. 79	0.58	0.63	0.65	0.61	0.62	
4 Sept. 79	0.60	0.82	0.61	0.71	0.68	19.21
11 Sept. 79	0.60	0.85	0.61	0.72	0.69	
16 Sept. 79	0.52	0.61	0.63	0.56	0.59	
21 Sept. 79	0.52	0.63	0.60	0.57	0.58	
2 Nov. 79	0.03	0.16	0.16	0.10	0.12	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.36	0.42	0.45	0.39	0.41	19.24
27 July 84	0.72	0.80	-	0.76	-	-
15 June 86	0.90	0.97	1.05	0.94	0.98	27.90
2 Aug. 86	0.95	0.79	0.87	0.87	0.87	25.92

APPENDIX A9

Regional Average Pan Evaporation x South Lake Salt Coefficient (cm)

Date	Same Day	Day Beofre	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.72	0.57	0.84	0.64	0.71	17.82
14 June 78	0.96	1.0	-	0.97	-	23.88
6 July 78	0.72	0.73	0.88	0.76	0.79	28.26
27 July 78	0.89	1.07	1.05	0.98	1.01	
2 Aug. 78	1.00	0.93	0.94	0.97	0.96	
7 Aug. 78	0.84	0.91	0.87	0.87	0.87	24.12
23 Aug. 78	0.90	-	0.71	-	0.89	
28 Aug. 78	0.71	0.80	0.57	0.76	0.69	
13 Sept. 78	0.30	0.26	0.32	0.28	0.29	15.73
23 Sept. 78	0.47	0.39	0.43	0.43	0.43	
9 Oct. 78	0.33	0.47	0.34	0.40	0.38	9.85
14 Oct. 78	-	0.41	0.33	0.33	0.33	
25 Oct. 78	0.32	0.23	0.35	0.28	0.28	
26 Oct. 78	0.35	0.18	0.35	0.30	0.30	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	-	-	-	-	-	-
14 July 79	-	0.81	0.87	0.81	0.91	27.28
9 Aug. 79	0.60	0.86	0.52	0.73	0.67	21.53
25 Aug. 79	0.61	0.67	0.68	0.64	0.65	
4 Sept. 79	0.63	0.86	0.64	0.75	0.71	20.09
11 Sept. 79	0.63	0.89	0.64	0.76	0.72	
16 Sept. 79	0.54	0.64	0.65	0.59	0.62	
21 Sept. 79	0.54	0.65	0.63	0.60	0.61	
2 Nov. 79	0.03	0.17	0.17	0.10	0.12	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.37	0.43	0.46	0.40	0.42	19.77
27 July 84	0.74	0.81	-	0.78	-	-
15 June 86	0.91	0.98	1.07	0.95	0.99	28.34
2 Aug. 86	0.96	0.80	0.81	0.88	0.89	26.27

APPENDIX A10

Regional Average Pan Evaporation x South East Lake Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.73	0.57	0.85	0.65	0.72	17.94
14 June 78	0.97	1.01	-	0.98	-	23.98
6 July 78	0.72	0.73	0.88	0.77	0.79	28.35
27 July 78	0.90	1.08	1.06	0.98	1.01	
2 Aug. 78	1.00	0.93	0.94	0.97	0.96	24.22
7 Aug. 78	0.84	0.91	0.88	0.88	0.88	
23 Aug. 78	0.90	-	0.71	-	0.89	
28 Aug. 78	0.71	0.81	0.57	0.76	0.69	
13 Sept. 78	0.30	0.26	0.32	0.28	0.29	15.73
23 Sept. 7	0.47	0.39	0.43	0.43	0.43	
9 Oct. 78	0.34	0.47	0.34	0.40	0.38	9.87
14 Oct. 78	-	0.41	0.33	0.33	0.33	
25 Oct. 78	0.32	0.23	0.35	0.28	0.28	
26 Oct. 78	0.35	0.18	0.35	0.30	0.30	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	-	-	-	-	-	-
14 July 79	-	0.81	0.87	0.81	0.90	27.22
9 Aug. 79	0.60	0.86	0.51	0.73	0.66	21.35
25 Aug. 79	0.61	0.66	0.68	0.63	0.64	
24 Sept. 79	0.63	0.86	0.64	0.75	0.71	20.13
11 Sept. 79	0.63	0.89	0.64	0.76	0.72	
16 Sept. 79	0.54	0.64	0.66	0.59	0.62	
21 Sept. 79	0.54	0.66	0.63	0.60	0.61	
2 Nov. 79	0.03	0.17	0.17	0.10	0.12	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.37	0.43	0.46	0.40	0.42	19.77
27 July 84	0.74	0.81	-	0.78	-	-
15 June 86	0.91	0.98	1.07	0.95	0.99	28.34
2 Aug. 86	0.96	0.80	0.89	0.88	0.89	26.27

APPENDIX A11

Regional Average Pan Evaporation x North Lake Salt Coefficient (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
13 May 78	0.67	0.53	0.78	0.60	0.66	16.49
14 June 78	0.89	0.93	-	0.90	-	22.06
6 July 78	0.66	0.67	0.81	0.70	0.73	26.04
27 July 78	0.82	0.99	0.97	0.90	0.93	
2 Aug. 78	0.92	0.86	0.87	0.89	0.88	22.27
7 Aug. 78	0.77	0.84	0.81	0.81	0.81	
23 Aug. 78	0.83	-	0.66	-	0.82	
28 Aug. 78	0.66	0.74	0.53	0.70	0.64	
13 Sept. 78	0.28	0.24	0.29	0.26	0.27	14.50
23 Sept. 78	0.43	0.36	0.40	0.40	0.40	
9 Oct. 78	0.31	0.43	0.32	0.37	0.35	9.08
14 Oct. 78	-	0.38	0.30	0.30	0.30	
25 Oct. 78	0.30	0.21	0.33	0.26	0.26	
26 Oct. 78	0.33	0.16	0.33	0.27	0.27	
26 Nov. 78	-	-	-	-	-	-
24 March 79	-	-	-	-	-	-
15 April 79	-	-	-	-	-	-
14 July 79	-	0.74	0.79	0.74	0.82	24.82
9 Aug. 79	0.55	0.78	0.47	0.67	0.61	19.49
25 Aug. 79	0.55	0.60	0.62	0.58	0.59	
4 Sept. 79	0.57	0.79	0.58	0.68	0.65	18.46
11 Sept. 79	0.57	0.81	0.58	0.69	0.66	
16 Sept. 79	0.50	0.58	0.60	0.54	0.57	
21 Sept. 79	0.50	0.60	0.58	0.55	0.56	
2 Nov. 79	0.03	0.16	0.16	0.10	0.11	-
14 Nov. 79	-	-	-	-	-	
9 June 84	0.34	0.39	0.42	0.36	0.38	18.01
27 July 84	0.68	0.95	-	0.72	-	-
15 June 86	0.86	0.92	1.01	0.90	0.93	26.66
2 Aug. 86	0.91	0.75	0.84	0.83	0.84	24.80

APPENDIX A12

Saltair Pan Evaporation for Night Correlations (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.94	1.14	0.94	1.04	1.01	33.3
1 Sept. 78	1.07	1.09	1.00	1.08	1.05	20.2
12 Sept. 78	-	-	-	-	-	
23 Sept. 78	0.51	0.46	0.44	0.49	0.47	
27 Sept. 78	0.51	0.53	0.51	0.52	0.51	
4 Sept. 79	1.11	1.11	0.91	1.11	1.04	26.8
21 Sept. 79	0.89	0.86	0.94	0.88	0.90	

APPENDIX A13

Saltair Pan Evaporation x South Arm Salt Coefficient (cm)
for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.88	1.06	0.88	0.97	0.94	31.0
1 Sept. 78	1.00	1.01	0.93	1.01	0.98	18.77
12 Sept. 78	-	-	-	-	-	
23 Sept. 78	0.47	0.43	0.41	0.46	0.44	
27 Sept. 78	0.47	0.49	0.47	0.48	0.47	
4 Sept. 79	1.02	1.02	0.84	1.02	0.96	24.66
21 Sept. 79	0.82	0.79	0.86	0.81	0.83	

APPENDIX A14

Saltair River Evaporation x Farmington Bay Salt Coefficient (cm) for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.89	1.08	0.89	0.98	0.96	31.54
1 Sept. 78	1.01	1.03	0.95	1.02	0.99	18.99
12 Sept. 78	0.39	0.97	0.43	0.68	0.59	
23 Sept. 78	0.48	0.43	0.41	0.46	0.44	
27 Sept. 78	0.48	0.50	0.48	0.49	0.48	
4 Sept. 79	1.07	1.07	0.88	1.07	1.00	25.62
21 Sept. 79	0.85	0.82	0.90	0.84	0.86	

APPENDIX A15

Bear River Refuge Pan Evaporation for Night Correlations (cm)

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.69	0.76	0.43	0.73	0.63	21.1
1 Sept. 78	0.61	0.64	0.59	0.62	0.61	11.6
12 Sept. 78	0.18	0.64	0.13	0.41	0.32	
23 Sept. 78	0.38	0.56	0.28	0.47	0.41	
27 Sept. 78	0.20	0.30	0.38	0.25	0.29	
21 Sept. 79	0.30	0.94	0.81	0.62	0.68	

APPENDIX A16

Bear River Refuge Pan Evaporation x North Arm Salt Coefficient (cm) for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	-	-	-	-	-	17.49
1 Sept. 78	0.51	0.53	0.49	0.51	0.51	9.60
12 Sept. 78	0.15	0.53	0.11	0.34	0.26	
23 Sept. 78	0.31	0.46	0.23	0.39	0.34	
27 Sept. 78	0.17	0.25	0.31	0.21	0.29	
4 Sept. 79	0.31	0.54	0.35	0.43	0.40	-
21 Sept. 79	0.25	0.77	0.67	0.51	0.56	

APPENDIX A17

Bear River Refuge Pan Evaporation x North Arm Salt Coefficients (cm) for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.65	0.72	0.41	0.69	0.60	20.0
1 Sept. 78	0.58	0.61	0.56	0.59	0.58	10.97
12 Sept. 78	0.17	0.61	0.12	0.39	0.30	
23 Sept. 78	0.36	0.53	0.26	0.44	0.38	
27 Sept. 78	0.19	0.28	0.36	0.23	0.27	
21 Sept. 79	0.29	0.90	0.77	0.59	0.65	

APPENDIX A18

Regional Average Pan Evaporation (cm) for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.88	0.88	0.74	0.88	0.83	25.8
1 Sept. 78	0.81	0.83	0.76	0.82	0.80	16.8
12 Sept. 78	0.28	0.53	0.32	0.40	0.37	
23 Sept. 78	0.50	0.42	0.46	0.46	0.38	
27 Sept. 78	0.41	0.43	0.42	0.41	0.41	
4 Sept. 79	-	-	-	-	-	21.5
21 Sept. 79	0.58	0.70	0.67	0.64	0.65	

APPENDIX A19

Regional Average Pan Evaporation x Whole Lake Salt Coefficient (cm) for Night Correlations

Date	Same Day	Day Before	Day After	2-Day Avg.	3-Day Avg.	Total Month
27 Aug. 78	0.79	0.79	0.67	0.79	0.75	23.19
1 Sept. 78	0.73	0.75	0.68	0.74	0.72	15.04
12 Sept. 78	0.25	0.47	0.29	0.36	0.33	
23 Sept. 78	0.45	0.38	0.41	0.41	0.34	
27 Sept. 78	0.37	0.38	0.38	0.37	0.37	
4 Sept. 79	-	-	-	-	-	19.24
21 Sept. 79	0.52	0.63	0.60	0.57	0.58	

APPENDIX B1

Daily Lake Area % Salt by Weight and Salt Coefficients[1]

Date	South Arm		Farmington Bay		North Arm		Bear River Bay	
	%	Coef.	%	Coef.	%	Coef.	%	Coef.
13 May 78	11.8	0.938	7.1	0.970	25.6	0.835	7.3	0.970
14 June 78	12.0	0.936	8.1	0.964	25.8	0.834	8.3	0.963
6 July 78	12.2	0.935	8.5	0.963	26.0	0.833	8.9	0.959
27 July 78	12.4	0.933	9.5	0.955	26.2	0.831	9.7	0.953
2 Aug. 78	12.4	0.933	9.6	0.955	26.2	0.831	9.8	0.952
7 Aug. 78	12.5	0.932	10.0	0.952	26.3	0.830	10.2	0.950
23 Aug. 78	12.6	0.932	10.3	0.949	26.4	0.830	10.4	0.948
28 Aug. 78	12.7	0.931	10.6	0.947	26.5	0.829	10.7	0.946
13 Sep. 78	12.8	0.930	11.1	0.943	26.6	0.828	11.3	0.942
23 Sep. 78	12.9	0.929	11.6	0.940	26.7	0.828	11.7	0.939
9 Oct. 78	13.0	0.928	12.0	0.936	26.8	0.827	12.0	0.936
14 Oct. 78	13.0	0.928	12.1	0.936	26.8	0.827	12.3	0.934
25 Oct. 78	13.1	0.927	12.5	0.932	27.0	0.826	12.7	0.931
26 Oct. 78	13.2	0.926	12.5	0.932	27.0	0.826	12.7	0.931
26 Nov. 78	13.4	0.925	13.5	0.924	27.2	0.825	13.1	0.923
24 Mar 79	11.7	0.938	3.6	0.988	25.3	0.837	5.8	0.977
15 Apr. 79	12.1	0.936	4.1	0.986	25.5	0.836	6.8	0.972
14 July 79	13.2	0.926	6.9	0.971	26.9	0.827	12.4	0.933
9 Aug. 79	13.6	0.924	7.7	0.967	27.4	0.825	14.0	0.920
25 Aug. 79	13.8	0.922	8.1	0.964	27.6	0.823	14.0	0.920
4 Sep. 79	13.9	0.921	8.4	0.962	27.6	0.823	13.0	0.928
11 Sep. 79	14.0	0.920	8.6	0.961	27.8	0.822	12.0	0.936
16 Sep. 79	14.0	0.920	8.7	0.960	27.8	0.822	11.1	0.943
21 Sep. 79	14.1	0.919	9.0	0.959	28.0	0.821	9.5	0.955
2 Nov. 79	14.6	0.915	10.1	0.951	28.5	0.818	6.0	0.976
14 Nov. 79	14.8	0.914	10.6	0.947	28.8	0.817	4.1	0.986
9 June 84	6.0	0.976	4.0	0.98	21.2	0.864	3.0	0.99
27 July 84	5.9	0.976	4.0	0.98	20.0	0.873	3.0	0.99
14 June 86	4.8	0.984	4.0	0.98	15.7	0.906	3.0	0.99
21 Aug. 86	5.1	0.982	4.0	0.98	17.1	0.912	3.0	0.99

[1]Salt coefficients were obtained from Jones (1933) data.

APPENDIX B2

Monthly Lake Area % Salt by Weight and Salt Coefficients

Month	South Arm %	South Arm Coef.	Farmington Bay %	Farmington Bay Coef.	North Arm %	North Arm Coef.	Bear River Bay %	Bear River Bay Coef.
May 78	11.8	0.938	7.1	0.970	25.6	0.835	7.3	0.970
June 78	12.0	0.936	8.1	0.964	25.8	0.834	8.3	0.963
July 78	12.2	0.935	9.0	0.959	26.1	0.832	9.3	0.956
Aug. 78	12.5	0.932	10.1	0.952	26.3	0.830	10.2	0.950
Sept. 78	12.8	0.930	11.3	0.942	26.6	0.828	11.5	0.940
Oct. 78	13.1	0.927	12.2	0.934	26.9	0.826	12.3	0.934
Nov. 78	13.4	0.925	13.5	0.924	27.2	0.825	13.7	0.923
March 79	11.7	0.938	3.6	0.988	25.3	0.837	5.8	0.977
April 79	12.1	0.936	4.1	0.986	25.5	0.836	6.8	0.972
July 79	13.2	0.926	6.9	0.971	26.9	0.827	12.4	0.933
Aug. 79	13.7	0.923	7.9	0.965	27.5	0.824	14.0	0.920
Sept. 79	14.0	0.920	8.7	0.960	27.8	0.822	11.3	0.942
Nov. 79	14.7	0.914	10.4	0.949	28.7	0.817	5.0	0.981
June 84	6.0	0.976	4.0	0.98	21.2	0.864	3.0	0.99
July 84	5.9	0.976	4.0	0.98	20.0	0.873	3.0	0.99
June 86	4.8	0.984	4.0	0.98	15.7	0.906	3.0	0.99
Aug. 86	5.1	0.982	4.0	0.98	15.2	0.912	3.0	0.99

APPENDIX B3

Daily Lake Section % Salt by Weight and Salt Coefficients

	Whole Lake		South Lake		So. East Lake		North Lake	
Date	%	Coef.	%	Coef.	%	Coef.	%	Coef.
13 May 78	14.9	0.913	10.2	0.948	9.5	0.954	19.5	0.877
14 June 78	15.3	0.908	10.7	0.945	10.1	0.949	20.0	0.873
6 July 78	15.6	0.907	11.0	0.943	10.5	0.946	20.3	0.810
27 July 78	16.1	0.903	11.4	0.941	11.0	0.943	20.7	0.867
2 Aug. 78	16.1	0.903	11.5	0.940	11.1	0.943	20.7	0.867
7 Aug. 78	16.3	0.901	11.7	0.939	11.3	0.941	20.9	0.866
23 Aug. 78	16.5	0.900	11.8	0.938	11.5	0.940	21.1	0.865
28 Aug. 78	16.6	0.899	12.0	0.936	11.7	0.939	21.2	0.864
13 Sept. 78	16.9	0.896	12.2	0.934	12.0	0.936	21.5	0.861
23 Sept. 78	17.1	0.895	12.5	0.932	12.3	0.933	21.7	0.860
9 Oct. 78	17.3	0.893	12.7	0.930	12.5	0.932	21.9	0.859
14 Oct. 78	17.3	0.893	12.7	0.930	12.6	0.931	22.0	0.858
25 Oct. 78	17.6	0.891	12.9	0.928	12.9	0.928	22.2	0.856
26 Oct. 78	17.6	0.891	13.0	0.926	12.9	0.928	22.2	0.856
26 Nov. 78	18.1	0.888	13.4	0.923	13.5	0.922	22.7	0.853
24 March 79	13.9	0.922	9.0	0.958	8.2	0.964	18.8	0.883
15 April 79	14.4	0.917	9.4	0.955	8.8	0.960	19.3	0.877
14 July 79	16.6	0.899	11.1	0.943	11.4	0.941	22.1	0.858
9 Aug. 79	17.3	0.893	11.6	0.940	12.2	0.934	22.9	0.853
25 Aug. 79	17.5	0.892	11.9	0.937	12.4	0.933	23.1	0.851
4 Sept. 79	17.4	0.892	12.1	0.935	12.3	0.934	22.7	0.855
11 Sept. 79	17.4	0.892	12.2	0.934	12.2	0.934	22.5	0.856
16 Sept. 79	17.2	0.895	12.2	0.934	12.0	0.936	22.2	0.858
21 Sept. 79	17.1	0.895	12.4	0.933	11.7	0.939	21.8	0.861
2 Nov. 79	17.1	0.895	13.1	0.925	11.3	0.941	21.0	0.865
14 Nov. 79	17.0	0.896	13.4	0.923	11.1	0.943	20.6	0.867
9 June 84	13.6	0.923	6.0	0.948	6.0	0.948	21.2	0.864
27 July 84	13.0	0.925	5.9	0.947	5.9	0.947	20.0	0.873
15 June 86	10.3	0.948	4.8	0.963	4.8	0.963	15.7	0.906
2 Aug. 86	10.1	0.949	5.1	0.962	5.1	0.962	15.2	0.908

APPENDIX B4

Monthly Lake Section % Salt by Weight and Salt Coefficients

Month	Whole Lake		South Lake		So. East Lake		North Lake	
	%	Coef.	%	Coef.	%	Coef.	%	Coef.
May 78	14.9	0.913	10.2	0.948	9.5	0.954	19.5	0.877
June 78	15.3	0.908	10.7	0.945	10.1	0.949	20.0	0.873
July 78	15.8	0.906	11.2	0.942	10.7	0.946	20.5	0.868
Aug. 78	16.4	0.901	11.7	0.939	11.4	0.940	21.0	0.865
Sept. 78	17.0	0.896	12.3	0.933	12.2	0.934	21.6	0.860
Oct. 78	17.4	0.892	12.8	0.929	12.7	0.930	22.0	0.858
Nov. 78	18.1	0.888	13.4	0.923	13.5	0.922	22.7	0.853
March 79	13.9	0.922	9.0	0.958	8.2	0.964	18.8	0.883
April 79	14.4	0.917	9.4	0.955	8.8	0.960	19.3	0.877
July 79	16.6	0.899	11.1	0.943	11.4	0.941	22.1	0.858
Aug. 79	17.4	0.893	11.7	0.939	12.3	0.933	23.0	0.852
Sept. 79	17.2	0.895	12.3	0.933	12.0	0.936	21.3	0.858
Nov. 79	17.0	0.896	13.2	0.924	11.2	0.942	20.8	0.866
June 84	13.6	0.923	6.0	0.948	6.0	0.948	21.2	0.864
July 84	13.0	0.925	5.9	0.947	5.9	0.947	20.0	0.873
June 86	10.3	0.948	4.8	0.963	4.8	0.963	15.7	0.906
Aug. 86	10.1	0.949	5.1	0.962	5.1	0.962	15.2	0.908

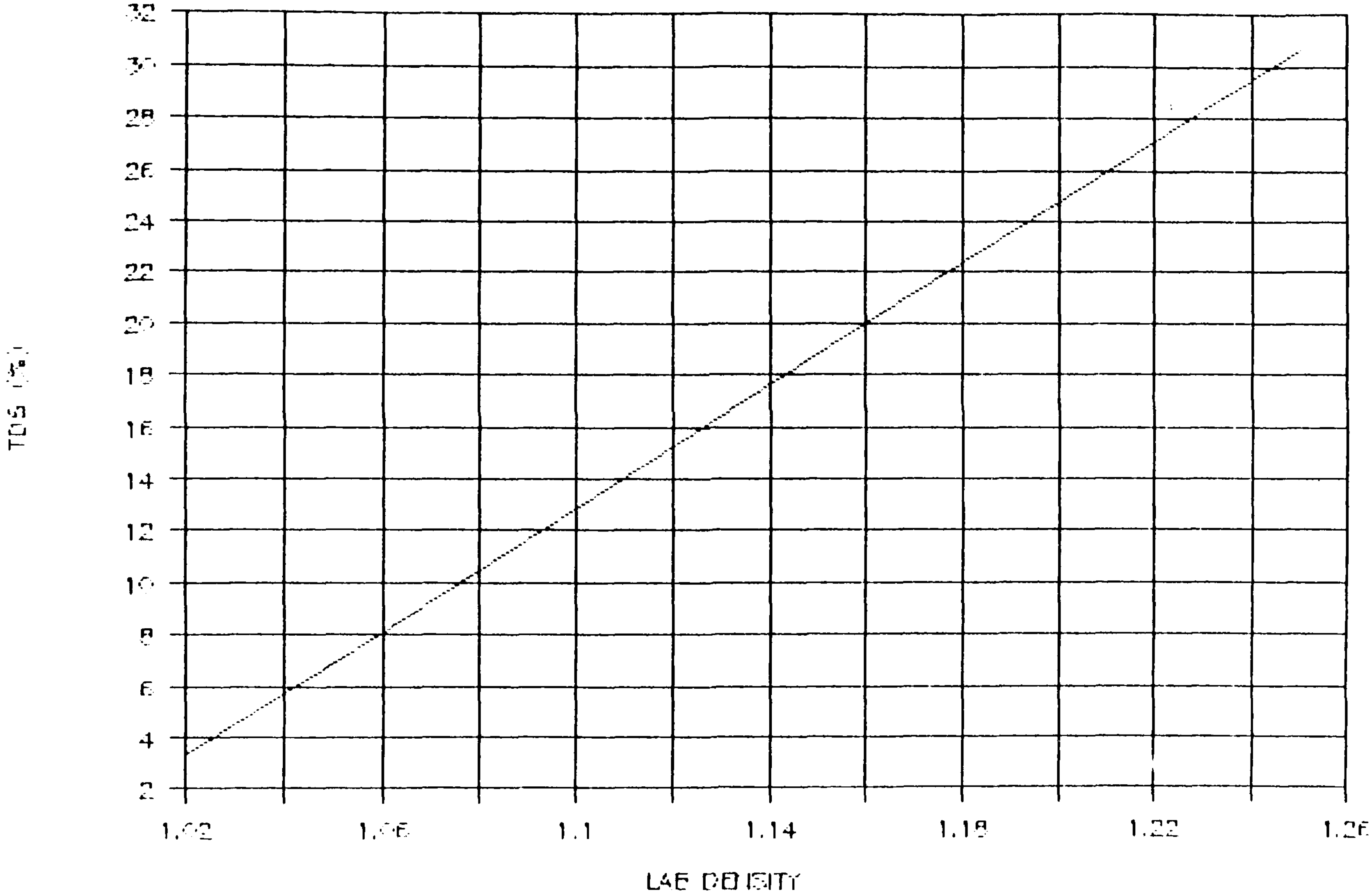
APPENDIX B5

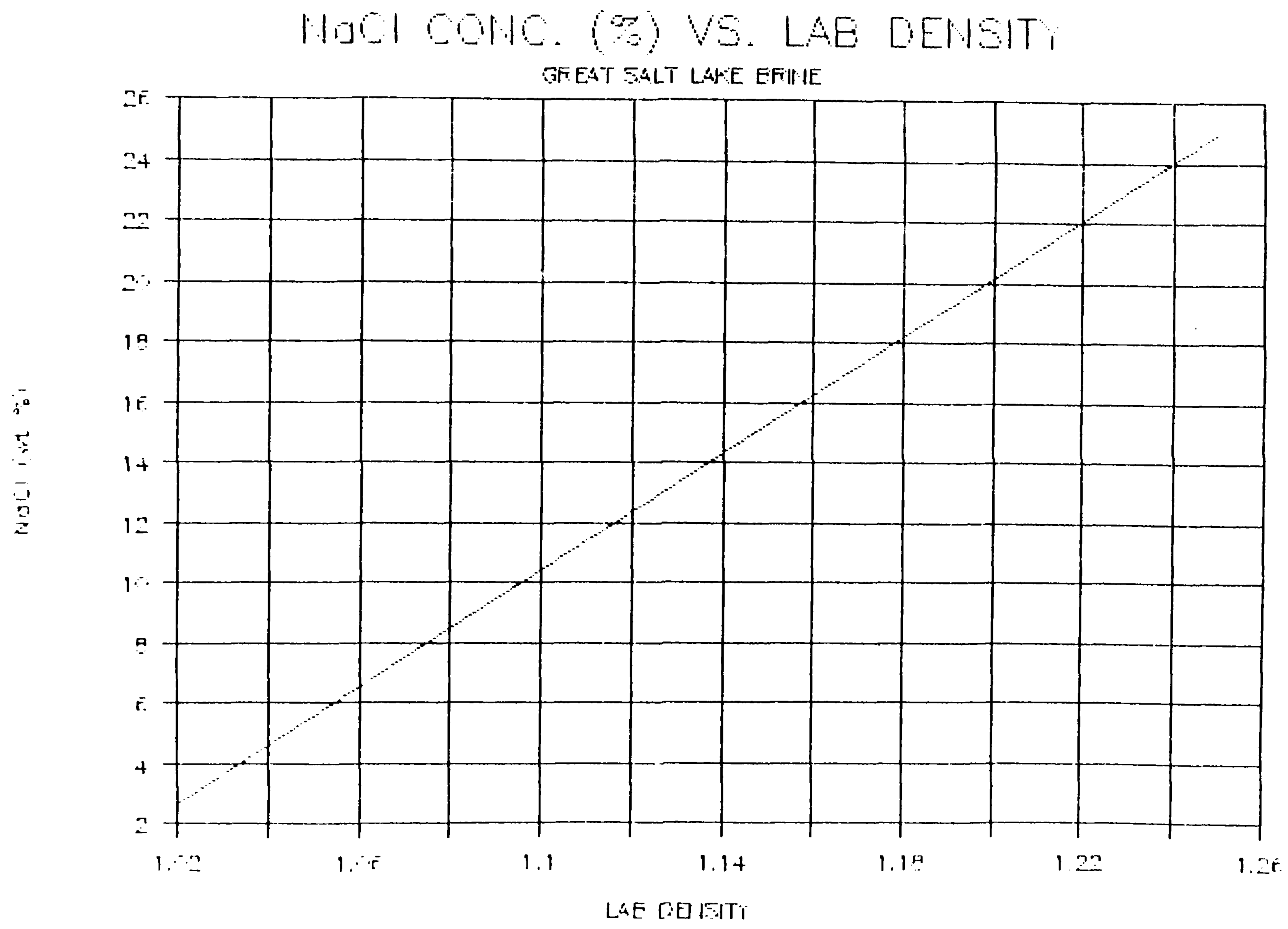
RELATIONSHIPS OBSERVED FOR GREAT SALT LAKE WATER FROM UGMS DATA:

1. Percent TDS vs Lab Density
2. Percent NaCl vs Lab Density
3. NaCl Concentration (g/l) vs Lab Density
4. Percent NaCl vs Percent TDS
5. NaCl Concentration (g/l) vs Percent TDS
6. NaCl Concentration (g/l) vs TDS Concentration (g/l)
7. Percent NaCl vs TDS Concentration (g/l)

%TDS VS. LAB DENSITY

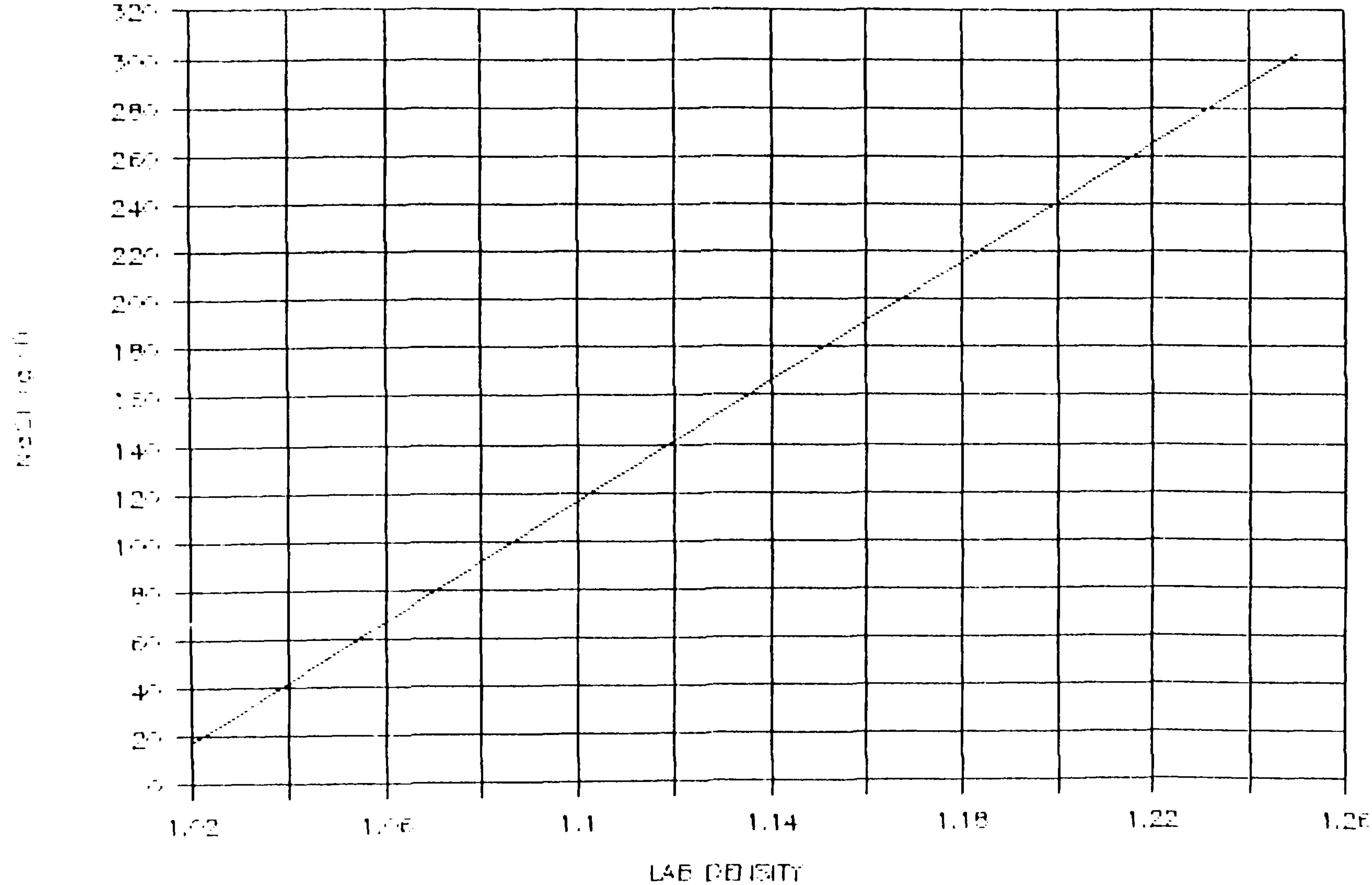
GREAT SALT LAKE BRINE




NaCl CONC. (%) VS. LAB DENSITY
GREAT SALT LAKE BRINE
26
24
22
20
18
16
14
12
10
8
6
4
2
1.02
1.06
1.1
1.14
1.18
1.22
1.26
LAB DENSITY
NaCl (wt %)

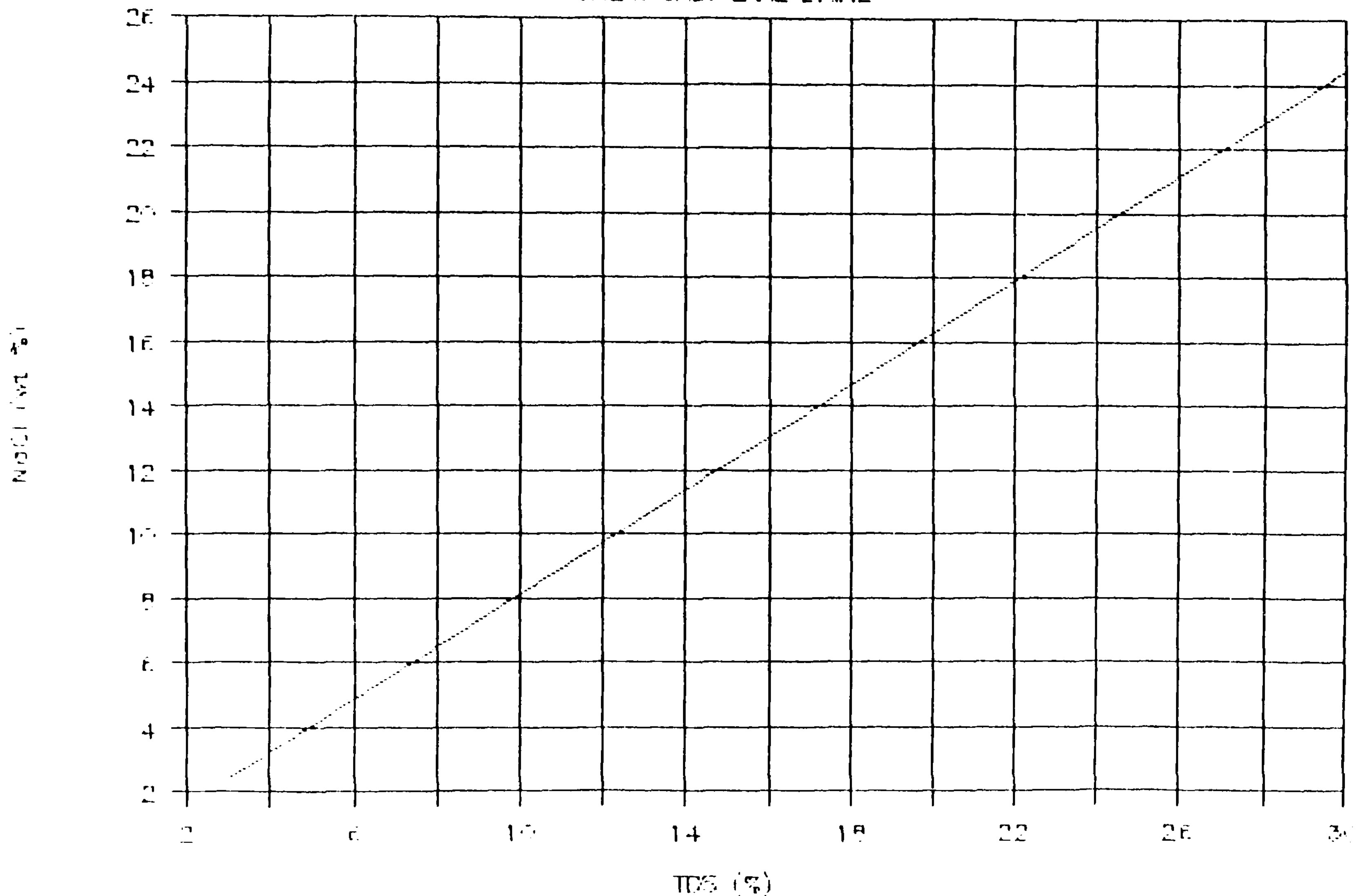
NaCl CONCENTRATION VS. LAB DENSITY

GREAT SALT LAKE BRINE

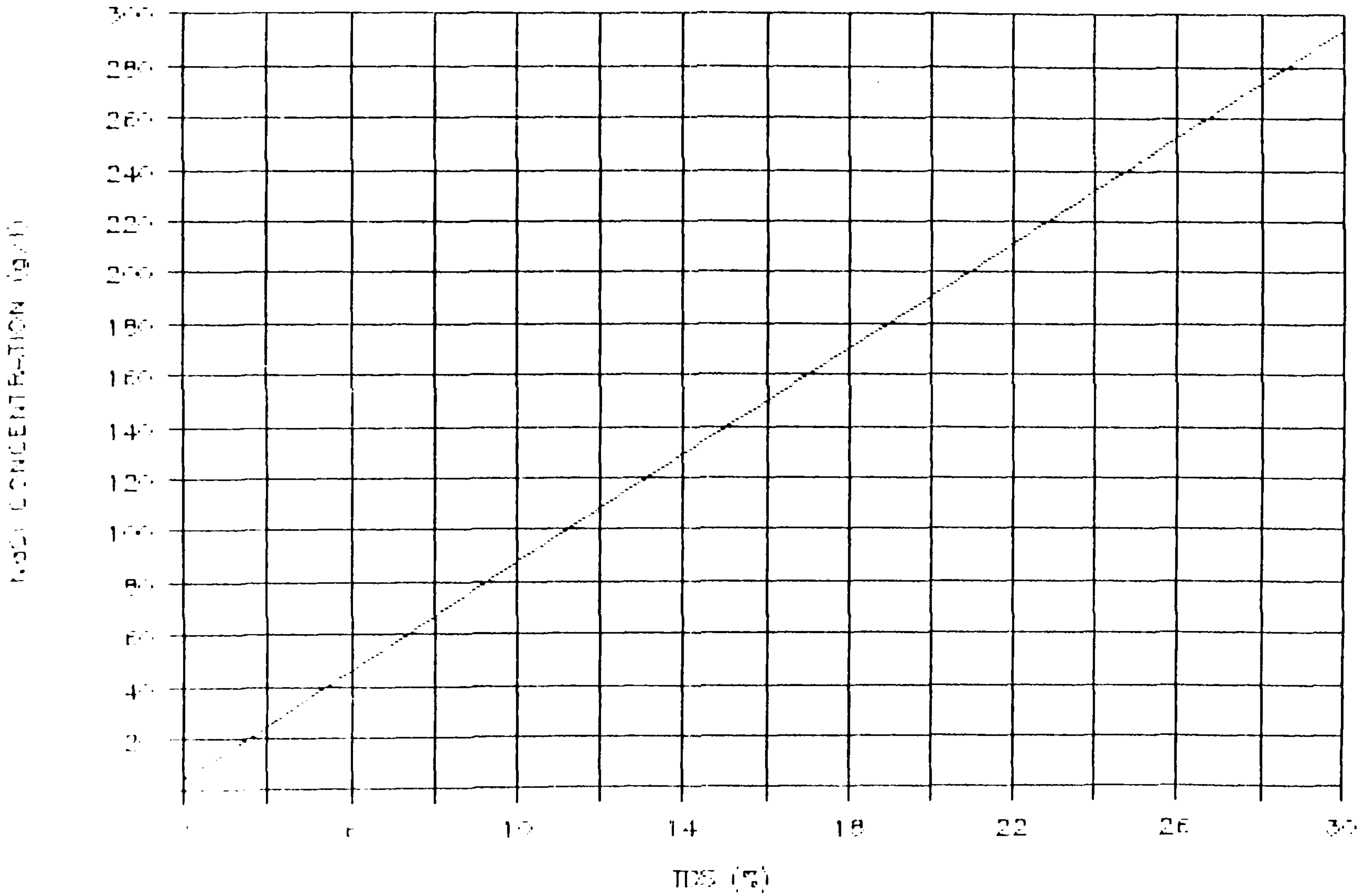


NaCl CONCENTRATION (%) VS. TDS (%)

GREAT SALT LAKE BRINE

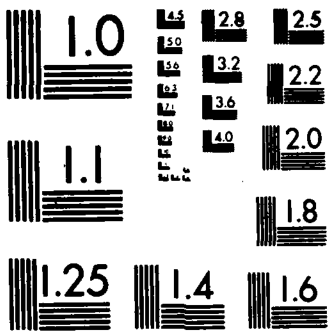


NaCl (g/l) VS. %TDS



AD-A192 042 EVALUATING EVAPORATION WITH SATELLITE THERMAL DATA(U) 2/2
BRIGHAM YOUNG UNIV PROVO UT DEPT OF CIVIL ENGINEERING
A W MILLER ET AL. NOV 87 AFOSR-TR-88-0131 AFOSR-87-0177

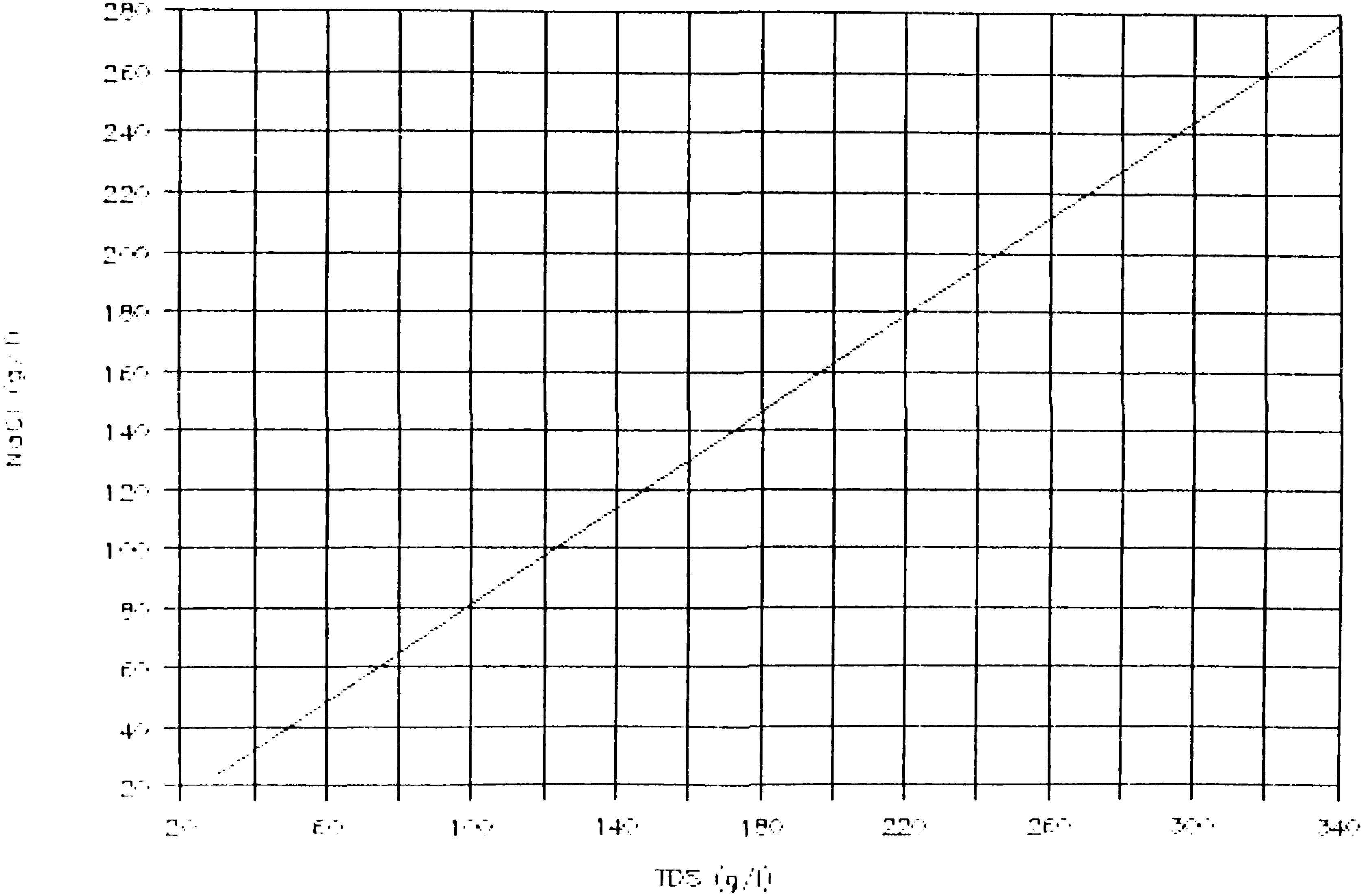
UNCLASSIFIED F/G 8/8 NL



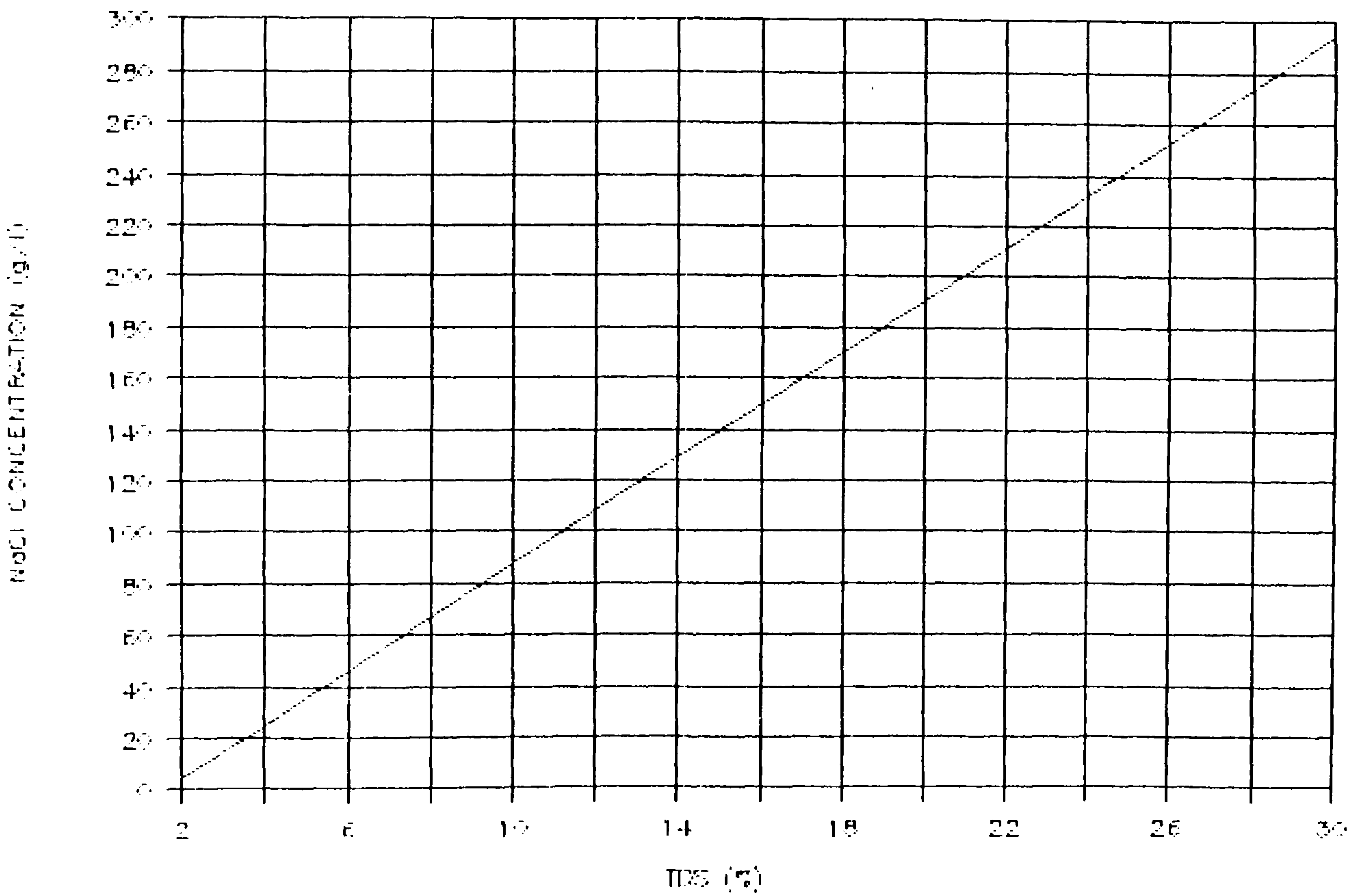
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

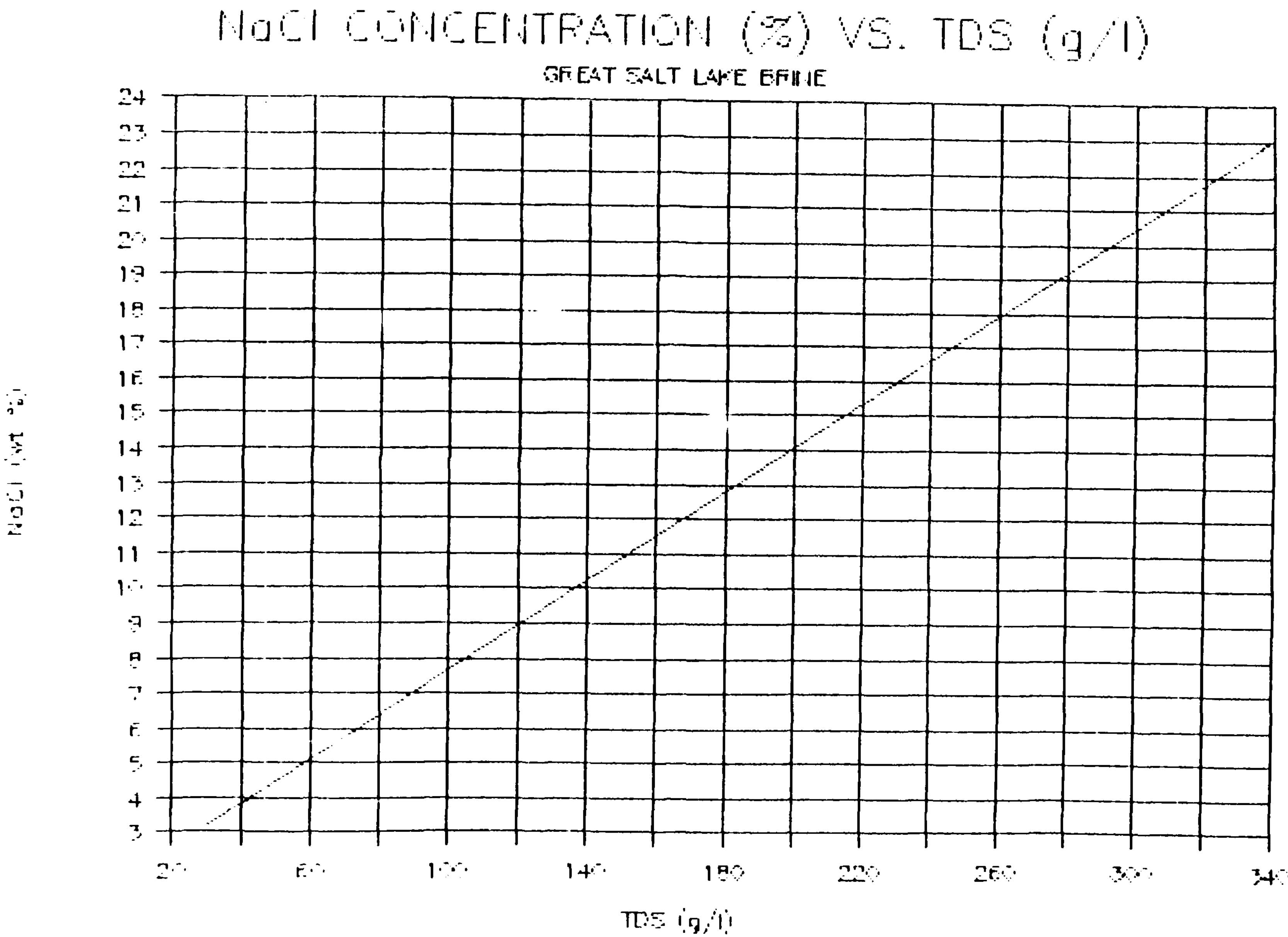
NaCl CONCENTRATION VS. TDS

GREAT SALT LAKE BRINE



NaCl (g/l) VS. %TDS




NaCl CONCENTRATION (%) VS. TDS (g/l)
GREAT SALT LAKE BRINE
NaCl (wt %)
TDS (g/l)
24
23
22
21
20
19
18
17
16
15
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12
11
10
9
8
7
6
5
4
3
20
60
100
140
180
220
260
300
340

APPENDIX C1

Daily Satellite Lake Area Temperatures (°C)

Date	South Arm	Farmington Bay	North Arm	Bear River Bay	Willard Bay
13 May 78	15.5	18.1	15.6	19.7	16.5
14 June 78	18.9	21.4	21.5	23.0	19.2
6 July 78	19.2	19.5	-	-	20.5
27 July 78	23.5	26.0	24.8	26.5	23.6
2 Aug. 78	24.2	24.8	-	-	-
7 Aug. 78	25.2	26.4	26.0	25.3	24.9
23 Aug. 78	20.0	20.1	21.6	20.9	21.0
28 Aug. 78	19.8	21.7	20.9	-	-
13 Sept. 78	15.0	14.2	16.5	14.1	14.0
23 Sept. 78	16.2	16.7	17.7	18.1	16.4
9 Oct. 78	16.8	17.8	17.2	17.2	16.7
14 Oct. 78	15.7	15.4	15.7	14.6	15.1
25 Oct. 78	12.1	10.4	11.4	10.3	12.0
26 Oct. 78	12.8	11.1	12.5	10.5	12.5
26 Nov. 78	1.9	0.5	2.4	-1.7	1.7
24 Mar. 79	8.3	9.4	8.8	8.5	1.0
15 Apr. 79	9.5	-	-	-	-
14 July 79	21.6	22.8	22.6	23.2	22.6
9 Aug. 79	-	-	20.9	-	-
25 Aug. 79	20.6	21.5	21.9	22.3	21.7
4 Sept. 79	19.4	20.2	-	21.2	19.8
11 Sept. 79	18.9	18.0	19.4	18.7	19.7
16 Sept. 79	19.5	20.5	20.7	20.4	20.3
21 Sept. 79	19.2	20.5	19.4	20.2	19.5
2 Nov. 79	7.0	-	7.3	-	-
14 Nov. 79	6.1	4.8	6.8	4.6	6.1
9 June 84	16.3	15.5	-	-	-
27 July 84	25.0	24.8	-	-	-
15 June 86	-	-	22.4	22.5	21.2
2 Aug. 86	24.1	-	24.4	23.9	24.3

APPENDIX C2

Monthly Satellite Lake Area Temperatures (°C)

Date	South Arm	Farmington Bay	North Arm	Bear River Bay	Willard Bay
May 78	15.5	18.1	15.6	19.7	16.5
June 78	18.9	21.4	21.5	23.0	19.2
July 78	21.3	22.8	24.8	26.5	22.1
Aug. 78	22.3	23.3	22.8	23.1	23.0
Sept. 78	15.6	15.5	17.1	16.1	15.2
Oct. 78	14.40	13.7	14.2	13.1	14.1
Nov. 78	1.9	0.5	2.4	-1.7	1.7
March 79	8.3	9.4	8.8	8.5	1.0
April 79	9.5	-	-	-	-
July 79	21.6	22.8	22.6	23.2	22.6
Aug 79	20.6	21.5	21.4	22.3	21.7
Sept. 79	19.3	19.8	19.8	20.1	19.8
Nov. 79	6.5	4.8	7.0	4.6	6.1
June 84	16.3	15.5	-	-	-
July 84	25.0	24.8	-	-	-
June 86	-	-	22.4	22.5	21.2
Aug. 86	24.1	-	24.4	23.9	24.3

APPENDIX C3

Daily Satellite Lake Section Temperatures (°C)

Date	Whole Lake [1]Wghted.	Whole Lake Unw.	South Lake Wghted.	South Lake Unw.	So. East Lake Wghted.	So. East Lake Unw.	North Lake Wghted.	North Lake Unw.
13 May 78	16.7	17.2	16.4	16.8	17.2	17.8	17.0	17.7
14 June	20.9	21.2	19.7	20.2	20.6	21.1	22.0	22.3
6 July 78	19.3	19.4	19.3	19.4	19.3	19.4	-	-
27 July 78	24.9	25.2	24.3	24.8	24.9	25.3	25.4	25.7
2 Aug. 78	24.4	24.5	24.4	24.5	24.4	24.5	-	-
7 Aug. 78	25.7	25.7	25.6	25.8	25.5	25.6	25.8	25.7
23 Aug. 78	20.7	20.6	20.0	20.1	20.3	20.3	21.4	21.3
28 Aug. 78	20.6	20.8	20.4	20.8	20.4	20.8	20.9	20.9
13 Sept 78	15.2	14.9	14.7	14.6	14.6	14.4	15.7	15.3
23 Sept 78	17.1	17.2	16.4	16.5	16.8	17.0	17.8	17.9
9 Oct. 78	17.2	17.2	17.1	17.3	17.2	17.3	17.2	17.2
14 Oct. 78	15.5	15.3	15.6	15.6	15.4	15.2	15.3	15.2
25 Oct. 78	11.3	11.1	11.5	11.3	11.2	10.9	11.0	10.9
26 Oct. 78	12.0	11.7	12.2	12.0	11.8	11.5	11.8	11.5
26 Nov. 78	1.2	0.8	1.4	1.2	0.7	0.2	1.0	0.4
24 Mar. 79	8.7	8.8	8.7	8.9	8.6	8.7	8.7	8.7
15 Apr. 79	9.5	9.5	9.5	9.5	9.5	9.5	-	-
14 July 79	22.4	22.6	22.0	22.2	22.3	22.5	22.8	22.9
9 Aug. 79	20.9	20.9	-	-	-	-	20.9	20.9
25 Aug. 79	21.5	21.6	20.9	21.1	21.3	21.5	22.0	22.1
4 Sept 79	20.1	20.3	19.7	19.8	20.1	20.3	21.2	21.2
11 Sept 79	18.9	18.8	18.6	18.5	18.6	18.5	19.2	19.1
16 Sept 79	20.2	20.3	19.8	19.6	20.0	19.7	20.6	19.9
21 Sept 79	19.7	19.8	19.6	19.9	19.8	20.0	19.7	19.8
2 Nov. 79	7.2	7.2	7.0	7.0	7.0	7.0	7.3	7.3
14 Nov. 79	5.9	5.6	5.7	5.5	5.4	5.2	6.1	5.7
9 June 84	16.0	15.6	16.0	15.9	16.0	15.9	-	-
27 July 84	24.9	24.9	24.9	24.9	24.9	24.9	-	-
15 June 86	22.4	22.4	-	-	22.5	22.5	22.4	22.5
18 Aug. 86	24.2	22.8	-	-	23.9	23.1	24.2	22.8

[1]Wghted and Unw. mean weighted and unweighted temperature averages. Area temperatures were averaged for sectional temperatures. Weighting was made on the basis of surface area.

APPENDIX C4

Monthly Satellite Lake Section Temperatures (°C)

Month	Whole Lake Wghted	Whole Lake Unw.	South Lake Wghted	South Lake Unw.	So. East Lake Wghted	So. East Lake Unw.	North Lake Wghted	North Lake Unw.
May 78	16.7	17.2	16.4	16.8	17.2	17.8	17.0	17.7
June 78	20.9	21.2	19.7	20.2	20.6	21.1	22.0	22.3
July 78	22.1	23.9	21.8	22.1	22.1	22.4	25.4	25.7
Aug. 78	22.9	22.9	22.6	22.8	22.7	22.8	22.7	22.6
Sept. 78	16.2	16.1	15.6	15.6	15.7	15.7	16.8	16.6
Oct. 78	14.0	13.9	14.1	14.1	13.9	13.7	13.8	13.7
Nov. 78	1.2	0.8	1.4	1.2	0.7	0.2	1.0	0.4
March 79	8.7	8.8	8.7	8.9	8.6	8.7	8.7	8.7
April 79	7.5	9.5	9.5	9.5	9.5	9.5	-	-
July 79	22.4	22.6	22.0	22.2	22.3	22.5	22.8	22.9
Aug. 79	21.2	21.5	20.9	21.1	21.3	21.5	21.5	21.5
Sept. 79	19.7	19.8	19.4	19.5	19.6	19.6	20.2	20.0
Nov. 79	6.6	5.7	6.4	6.3	6.2	6.1	6.7	6.5
June 84	16.0	15.9	16.0	15.9	16.0	15.9	-	-
July 84	24.9	24.9	24.9	24.9	24.9	24.9	-	-
June 86	22.4	22.5	-	-	22.5	22.5	22.4	22.5
Aug. 86	24.2	22.8	-	-	23.9	23.1	24.2	22.8

APPENDIX C5

Night Satellite Lake Area Temperatures (°C)

Date	South Arm	Farmington Bay	North Arm	Bear River Bay	Willard Bay
27 Aug. 78	17.6	17.1	17.8	-	-
1 Sep. 78	18.4	17.9	18.8	17.8	17.0
12 Sep. 78	14.6	12.2	15.1	11.7	13.7
23 Sep. 78	13.4	12.1	13.9	12.3	13.0
27 Sep. 78	14.2	14.1	-	13.6	10.7
4 Sep. 79	18.9	17.6	19.2	18.2	17.8
21 Sep. 79	17.6	16.4	17.8	16.1	16.3

APPENDIX C6

Monthly Night Satellite Lake Area Temperatures (°C)

Date	South Arm	Farmington Bay	North Arm	Bear River Bay	Willard Bay
Aug. 78	17.6	17.1	17.8	-	-
Sept. 78	15.2	14.1	15.9	13.9	13.6
Sept. 79	18.3	17.0	18.5	17.2	17.1

APPENDIX C7

Night Satellite Lake Section Unweighted Temperatures (°C)

Date	Whole Lake	South Lake	So. East Lake	North Lake
27 Aug. 78	17.5	17.4	17.4	17.8
1 Sept. 78	18.2	18.2	18.0	18.3
12 Sept. 78	13.4	13.4	12.8	13.4
23 Sept. 78	12.9	12.8	12.6	13.1
27 Sept. 78	14.0	14.2	14.0	13.6
4 Sept. 79	18.5	18.3	18.2	18.7
21 Sept. 79	17.0	17.0	16.7	17.0

APPENDIX C8

Monthly Night Satellite Lake Section Unweighted Temperatures (°C)

Month	Whole Lake	South Lake	So. East Lake	North Lake
Aug. 78	17.5	17.4	17.4	17.8
Sept. 78	14.6	14.7	14.4	14.6
Sept. 78	17.8	17.7	17.5	17.9

APPENDIX D1

Daily Ratios of Lake Area Temperature/% Salt Weight

Date	South Arm	Farmington Bay	North Arm	Bear River Bay
13 May 78	1.31	2.55	0.61	2.70
14 June 78	1.58	2.64	0.83	2.77
6 July 78	1.57	2.29	-	-
27 July 78	1.90	2.74	0.95	2.73
2 Aug. 78	1.95	2.58	-	-
7 Aug. 78	2.02	2.64	0.99	2.48
23 Aug. 78	1.59	1.95	0.82	2.01
29 Aug. 78	1.56	2.05	0.79	-
13 Sep. 78	1.17	1.28	0.62	1.25
23 Sep. 78	1.26	1.44	0.66	1.55
9 Oct. 78	1.29	1.48	0.64	1.43
14 Oct. 78	1.21	1.27	0.59	1.17
25 Oct. 78	0.92	0.83	0.42	0.81
26 Oct. 78	0.97	0.89	0.46	0.83
26 Nov. 78	0.14	0.04	0.09	0.12
24 Mar. 79	0.71	2.61	0.35	1.47
15 Apr. 79	0.79	-	-	-
14 July 79	1.64	3.30	0.84	1.87
9 Aug. 79	-	-	0.76	-
25 Aug. 79	1.49	2.65	0.77	1.59
4 Sep. 79	1.40	2.40	-	1.63
11 Sep. 79	1.35	2.09	0.70	1.56
16 Sep. 79	1.39	2.36	0.74	1.84
21 Sep. 79	1.36	2.28	0.69	2.13
2 Nov. 79	0.48	-	0.26	-
14 Nov. 79	0.41	0.45	0.24	1.12
9 June 84	2.72	3.5	-	-
27 July 84	4.24	6.0	-	-
15 June 86	-	-	1.43	7.5
2 Aug. 86	4.73	-	1.61	8.0

APPENDIX D2

Monthly Ratios of Lake Area Temperature/% Salt Weight

Date	South Arm	Farmington Bay	North Arm	Bear River Bay
May 78	1.31	2.55	0.61	2.70
June 78	1.58	2.64	0.83	2.77
July 78	1.74	2.52	0.95	2.73
Aug. 78	1.78	2.31	0.87	2.25
Sept. 78	1.22	1.36	0.64	1.40
Oct. 78	1.10	1.12	0.53	1.07
Nov. 78	0.14	0.04	0.09	0.12
March 79	0.71	2.61	0.35	1.47
April 79	0.79	-	-	-
July 79	1.64	3.30	0.84	1.87
Aug. 79	1.49	2.65	0.78	1.59
Sept. 79	1.38	2.28	0.71	1.79
Nov. 79	0.45	0.45	0.25	1.12
June 84	2.72	3.5	-	-
July 84	4.24	6.0	-	-
June 86	-	-	1.43	7.5
Aug. 86	4.73	-	1.61	8.0

APPENDIX E

Lake Area Temperature x Salt Coefficient

Date	Daily: South Arm	Daily: North Arm	Month	Monthly: South Arm	Monthly: North Arm
13 May 78	14.5	13.0	May 78	14.5	13.0
14 June 78	17.7	17.9	June 78	17.7	17.9
6 July 78	18.0	-	July 78	20.0	20.0
27 July 78	21.9	20.6			
2 Aug. 78	22.6	-	Aug. 78	20.8	18.9
7 Aug. 78	23.5	21.6			
23 Aug. 78	18.6	17.9			
28 Aug. 78	18.4	17.3			
13 Sept. 78	14.0	13.7	Sept. 78	14.5	14.2
23 Sept. 78	15.0	14.7			
1 Oct. 78	15.6	14.2	Oct. 78	13.3	11.7
14 Oct. 78	14.6	13.0			
25 Oct. 78	11.2	9.4			
26 Oct. 78	11.8	10.3			
26 Nov. 78	1.8	2.0	Nov. 78	1.8	2.0
24 March 79	7.8	7.4	March 79	7.8	7.4
15 Apr. 79	8.9	-	April 79	8.9	-
14 July 79	20.0	18.7	July 79	20.0	18.7
9 Aug. 79	-	17.2	Aug. 79	19.0	17.6
25 Aug. 79	19.0	18.0			
4 Sept. 79	17.9	-	Sept. 79	17.7	16.3
11 Sept. 79	17.4	15.9			
16 Sept. 79	17.9	17.0			
21 Sept. 79	17.6	15.9			
2 Nov. 79	6.4	6.0	Nov. 79	6.0	5.8
14 Nov. 79	5.6	5.6			
9 June 84	15.9	-	June 84	15.9	-
27 July 84	24.4	-	July 84	24.4	-
15 June 86	-	20.3	June 86	-	20.3
2 Aug. 86	23.7	22.2	Aug. 86	27.3	27.2

APPENDIX F1

Four-Day Average Model Evaporation[1] (cm) from Salt Lake Airport Data

Date	(1)	(2)	(3)	(4)	(5)
13 May 78	0.93	0.55	0.58	0.53	0.55
14 June 78	1.18	0.65	0.68	0.63	0.65
6 July 78	1.08	0.63	0.65	0.60	0.63
27 July 78	1.25	0.63	0.63	0.60	0.63
2 Aug. 78	1.25	0.60	0.63	0.58	0.60
7 Aug. 78	1.25	0.63	0.65	0.63	0.65
23 Aug. 78	1.13	0.55	0.55	0.53	0.55
28 Aug. 78	1.03	0.50	0.53	0.48	0.50
13 Sept. 78	0.70	0.35	0.35	0.35	0.35
23 Sept. 78	0.63	0.38	0.38	0.35	0.38
9 Oct. 78	0.65	0.30	0.30	0.30	0.30
14 Oct. 78	0.55	0.28	0.28	0.25	0.28
25 Oct. 78	0.43	0.20	0.20	0.20	0.20
26 Oct. 78	0.43	0.20	0.20	0.20	0.20
26 Nov. 78	0.05	0.05	0.05	0.05	0.05
24 March 79	0.03	0.03	0.03	0.03	0.03
15 April 79	0.75	0.43	0.45	0.45	0.43
14 July 79	1.25	0.70	0.73	0.68	0.70
9 Aug. 79	0.95	0.50	0.53	0.50	0.53
25 Aug. 79	0.97	0.50	0.53	0.48	0.50
4 Sept. 79	1.17	0.55	0.58	0.53	0.55
11 Sept. 79	0.80	0.40	0.43	0.40	0.40
16 Sept. 79	0.53	0.38	0.40	0.35	0.38
21 Sept. 79	0.90	0.40	0.43	0.40	0.40
2 Nov. 79	0.13	0.08	0.08	0.08	0.08
14 Nov. 79	0.23	0.13	0.13	0.13	0.12
9 June 84	0.60	0.50	0.50	0.45	0.50
27 July 84	1.18	0.70	0.70	0.65	0.70

(1) Model Pan Evaporation (zero salt concentration)
(2) Model Lake Evaporation with South Arm Salt Coefficient
(3) Model Lake Evaporation with Farmington Bay Salt Coefficient
(4) Model Lake Evaporation with Whole Lake Salt Coefficient
(5) Model Lake Evaporation with South Lake Salt Coefficient

[1]Model evaporations were generated by the Morton (1975) model for freshwater pan values and lake values with different salt concentrations.

APPENDIX F2

Total Monthly Model Evaporation (cm) from Salt Lake Airport Data

Month	(1)	(2)	(3)	(4)	(5)
May 78	21.7	15.0	15.7	14.6	15.2
June 78	31.0	18.6	19.3	18.1	18.9
July 78	36.8	19.9	20.5	19.3	20.1
Aug. 78	31.4	16.1	16.4	15.5	16.2
Sept. 78	19.6	10.8	11.0	10.4	10.9
Oct. 78	15.3	7.4	7.5	7.2	7.5
Nov. 78	3.2	2.1	2.1	2.0	2.1
March 79	7.8	6.7	7.2	6.5	6.8
April 79	16.4	10.7	11.5	10.4	10.9
July 79	37.4	19.9	21.1	19.3	20.3
Aug. 79	28.2	15.6	16.5	15.1	15.9
Sept. 79	26.0	12.5	13.1	12.1	12.7
Nov. 79	4.1	2.5	2.6	2.5	2.5
June 84	-	-	-	-	-
July 84	-	-	-	-	-
June 86	31.0	19.7	-	-	-
Aug. 86	30.1	17.6	-	-	-

(1) Model Pan Evaporation (zero salt concentration)
(2) Model Lake Evaporation with South Arm Salt Coefficient
(3) Model Lake Evaporation with Farmington Bay Salt Coefficient
(4) Model Lake Evaporation with Whole Lake Salt Coefficient
(5) Model Lake Evaporation with South Lake Salt Coefficient

APPENDIX F3

Daily Lake Area Salt Coefficients[1] from Model Evaporations

Date	South Arm	Farmington Bay	North Arm	Bear River Bay
13 May 78	0.89	0.93	0.80	0.93
14 June 78	0.89	0.93	0.79	0.093
6 July 78	0.89	0.92	0.79	0.92
27 July 78	0.89	0.91	0.79	0.91
2 Aug. 78	0.89	0.91	0.79	0.91
7 Aug. 78	0.89	0.91	0.79	0.91
23 Aug. 78	0.89	0.91	0.79	0.91
28 Aug. 78	0.89	0.90	0.79	0.90
13 Sep. 78	0.89	0.90	0.79	0.90
23 Sep. 78	0.89	0.89	0.79	0.89
9 Oct. 78	0.89	0.89	0.79	0.89
14 Oct. 78	0.89	0.89	0.79	0.89
25 Oct. 78	0.89	0.89	0.79	0.89
26 Oct. 78	0.89	0.89	0.79	0.89
26 Nov. 78	0.89	0.88	0.79	0.88
24 Mar 79	0.89	0.96	0.80	0.94
15 Apr. 79	0.89	0.96	0.80	0.93
14 July 79	0.89	0.93	0.79	0.89
9 Aug. 79	0.88	0.93	0.79	0.88
25 Aug. 79	0.88	0.93	0.78	0.88
4 Sep. 79	0.88	0.93	0.78	0.89
11 Sep. 79	0.88	0.92	0.78	0.89
16 Sep. 79	0.88	0.92	0.78	0.90
21 Sep. 79	0.88	0.92	0.78	0.92
2 Nov. 79	0.87	0.91	0.78	0.94
14 Nov. 79	0.87	0.90	0.78	0.96
9 June 84	0.94	-	0.82	-
27 July 84	0.94	-	0.83	-
14 June 86	0.95	-	0.86	-
21 Aug. 86	0.95	-	0.87	-

[1]Salt coefficents were determined by running the Morton (1975) model with and without salt concentrations and comparing the results.

APPENDIX G1

Sample Output from the PCIPS Program for the North Arm, October 25, 1978

Mean	48.19
Std. Dev.	4.24
Entropy	3.88
Minimum	37
Maximum	68
No. Pixels	5,453

Zero intensity pixels not counted

Histogram ----------

Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count
0	0	32	0	64	2	96	0	128	0	160	0	192	0	224	0
1	0	33	0	65	0	97	0	129	0	161	0	193	0	225	0
2	0	34	0	66	0	98	0	130	0	162	0	194	0	226	0
3	0	35	0	67	0	99	0	131	0	163	0	195	0	227	0
4	0	36	0	68	2	100	0	132	0	164	0	196	0	228	0
5	0	37	2	69	0	101	0	133	0	165	0	197	0	229	0
6	0	38	18	70	0	102	0	134	0	166	0	198	0	230	0
7	0	39	76	71	0	103	0	135	0	167	0	199	0	231	0
8	0	40	222	72	0	104	0	136	0	168	0	200	0	232	0
9	0	41	277	73	0	105	0	137	0	169	0	201	0	233	0
10	0	42	246	74	0	106	0	138	0	170	0	202	0	234	0
11	0	43	197	75	0	107	0	139	0	171	0	203	0	235	0
12	0	44	211	76	0	108	0	140	0	172	0	204	0	236	0
13	0	45	207	77	0	109	0	141	0	173	0	205	0	237	0
14	0	46	213	78	0	110	0	142	0	174	0	206	0	238	0
15	0	47	274	79	0	111	0	143	0	175	0	207	0	239	0
16	0	48	373	80	0	112	0	144	0	176	0	208	0	240	0
17	0	49	500	81	0	113	0	145	0	177	0	209	0	241	0
18	0	50	548	82	0	114	0	146	0	178	0	210	0	242	0
19	0	51	744	83	0	115	0	147	0	179	0	211	0	243	0
20	0	52	727	84	0	116	0	148	0	180	0	212	0	244	0
21	0	53	387	85	0	117	0	149	0	181	0	213	0	245	0
22	0	54	159	86	0	118	0	150	0	182	0	214	0	246	0
23	0	55	40	87	0	119	0	151	0	183	0	215	0	247	0
24	0	56	16	88	0	120	0	152	0	184	0	216	0	248	0
25	0	57	4	89	0	121	0	153	0	185	0	217	0	249	0
26	0	58	1	90	0	122	0	154	0	186	0	218	0	250	0
27	0	59	2	91	0	123	0	155	0	187	0	219	0	251	0
28	0	60	2	92	0	124	0	156	0	188	0	220	0	252	0
29	0	61	1	93	0	125	0	157	0	189	0	221	0	253	0
30	0	62	1	94	0	126	0	158	0	190	0	222	0	254	0
31	0	63	1	95	0	127	0	159	0	191	0	223	0	255	0

From the mean intensity value, the surface temperature is 11.4 °C.

APPENDIX G2

Sample Output from the PCIPS Program for Bear River Bay, October 25, 1978

```
Mean          45.14
Std. Dev.      4.11
Entropy        3.83
Minimum       39
Maximum       63
No. Pixels   651
```

Zero intensity pixels not counted

Histogram ----------

Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count
0	0	32	0	64	0	96	0	128	0	160	0	192	0	224	0
1	0	33	0	65	0	97	0	129	0	161	0	193	0	225	0
2	0	34	0	66	0	98	0	130	0	162	0	194	0	226	0
3	0	35	0	67	0	99	0	131	0	163	0	195	0	227	0
4	0	36	0	68	0	100	0	132	0	164	0	196	0	228	0
5	0	37	0	69	0	101	0	133	0	165	0	197	0	229	0
6	0	38	0	70	0	102	0	134	0	166	0	198	0	230	0
7	0	39	8	71	0	103	0	135	0	167	0	199	0	231	0
8	0	40	28	72	0	104	0	136	0	168	0	200	0	232	0
9	0	41	80	73	0	105	0	137	0	169	0	201	0	233	0
10	0	42	93	74	0	106	0	138	0	170	0	202	0	234	0
11	0	43	70	75	0	107	0	139	0	171	0	203	0	235	0
12	0	44	55	76	0	108	0	140	0	172	0	204	0	236	0
13	0	45	60	77	0	109	0	141	0	173	0	205	0	237	0
14	0	46	54	78	0	110	0	142	0	174	0	206	0	238	0
[illegible]	0	47	48	79	0	111	0	143	0	175	0	207	0	239	0
[illegible]	0	48	39	80	0	112	0	144	0	176	0	208	0	240	0
17	0	49	37	81	0	113	0	145	0	177	0	209	0	241	0
18	0	50	18	82	0	114	0	146	0	178	0	210	0	242	0
19	0	51	10	83	0	115	0	147	0	179	0	211	0	243	0
20	0	52	13	84	0	116	0	148	0	180	0	212	0	244	0
21	0	53	7	85	0	117	0	149	0	181	0	213	0	245	0
22	0	54	7	86	0	118	0	150	0	182	0	214	0	246	0
23	0	55	4	87	0	119	0	151	0	183	0	215	0	247	0
24	0	56	7	88	0	120	0	152	0	184	0	216	0	248	0
25	0	57	4	89	0	121	0	153	0	185	0	217	0	249	0
26	0	58	2	90	0	122	0	154	0	186	0	218	0	250	0
27	0	59	2	91	0	123	0	155	0	187	0	219	0	251	0
28	0	60	2	92	0	124	0	156	0	188	0	220	0	252	0
29	0	61	0	93	0	125	0	157	0	189	0	221	0	253	0
30	0	62	2	94	0	126	0	158	0	190	0	222	0	254	0
31	0	63	1	95	0	127	0	159	0	191	0	223	0	255	0

From the mean intensity value, the surface temperature is 10.3 °C.

APPENDIX G3

Sample Output from the PCIPS Program for Willard Bay, October 25, 1978

Mean	49.79
Std. Dev.	2.22
Entropy	2.54
Minimum	46
Maximum	61
No. Pixels	125

Zero intensity pixels not counted

Histogram ----------

Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count
0	0	32	0	64	0	96	0	128	0	160	0	192	0	224	0
1	0	33	0	65	0	97	0	129	0	161	0	193	0	225	0
2	0	34	0	66	0	98	0	130	0	162	0	194	0	226	0
3	0	35	0	67	0	99	0	131	0	163	0	195	0	227	0
4	0	36	0	68	0	100	0	132	0	164	0	196	0	228	0
5	0	37	0	69	0	101	0	133	0	165	0	197	0	229	0
6	0	38	0	70	0	102	0	134	0	166	0	198	0	230	0
7	0	39	0	71	0	103	0	135	0	167	0	199	0	231	0
8	0	40	0	72	0	104	0	136	0	168	0	200	0	232	0
9	0	41	0	73	0	105	0	137	0	169	0	201	0	233	0
10	0	42	0	74	0	106	0	138	0	170	0	202	0	234	0
11	0	43	0	75	0	107	0	139	0	171	0	203	0	235	0
12	0	44	0	76	0	108	0	140	0	172	0	204	0	236	0
13	0	45	0	77	0	109	0	141	0	173	0	205	0	237	0
14	0	46	1	78	0	110	0	142	0	174	0	206	0	238	0
15	0	47	4	79	0	111	0	143	0	175	0	207	0	239	0
[illegible]	0	48	17	80	0	112	0	144	0	176	0	208	0	240	0
17	0	49	51	81	0	113	0	145	0	177	0	209	0	241	0
18	0	50	29	82	0	114	0	146	0	178	0	210	0	242	0
19	0	51	11	83	0	115	0	147	0	179	0	211	0	243	0
20	0	52	2	84	0	116	0	148	0	180	0	212	0	244	0
21	0	53	2	85	0	117	0	149	0	181	0	213	0	245	0
22	0	54	2	86	0	118	0	150	0	182	0	214	0	246	0
23	0	55	1	87	0	119	0	151	0	183	0	215	0	247	0
24	0	56	2	88	0	120	0	152	0	184	0	216	0	248	0
25	0	57	0	89	0	121	0	153	0	185	0	217	0	249	0
26	0	58	1	90	0	122	0	154	0	186	0	218	0	250	0
27	0	59	0	91	0	123	0	155	0	187	0	219	0	251	0
28	0	60	1	92	0	124	0	156	0	188	0	220	0	252	0
29	0	61	1	93	0	125	0	157	0	189	0	221	0	253	0
30	0	62	0	94	0	126	0	158	0	190	0	222	0	254	0
31	0	63	0	95	0	127	0	159	0	191	0	223	0	255	0

From the mean intensity value, the surface temperature is 12.0 °C.

APPENDIX G4

Sample Output from the PCIPS Program for the South Arm, October 25, 1978

Mean	49.99
Std. Dev.	1.84
Entropy	2.74
Minimum	40
Maximum	64
No. Pixels	6,965

Zero intensity pixels not counted

Histogram ----------

Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count
0	0	32	0	64	1	96	0	128	0	160	0	192	0	224	0
1	0	33	0	65	0	97	0	129	0	161	0	193	0	225	0
2	0	34	0	66	0	98	0	130	0	162	0	194	0	226	0
3	0	35	0	67	0	99	0	131	0	163	0	195	0	227	0
4	0	36	0	68	0	100	0	132	0	164	0	196	0	228	0
5	0	37	0	69	0	101	0	133	0	165	0	197	0	229	0
6	0	38	0	70	0	102	0	134	0	166	0	198	0	230	0
7	0	39	0	71	0	103	0	135	0	167	0	199	0	231	0
8	0	40	1	72	0	104	0	136	0	168	0	200	0	232	0
9	0	41	8	73	0	105	0	137	0	169	0	201	0	233	0
10	0	42	20	74	0	106	0	138	0	170	0	202	0	234	0
11	0	43	45	75	0	107	0	139	0	171	0	203	0	235	0
12	0	44	56	76	0	108	0	140	0	172	0	204	0	236	0
13	0	45	72	77	0	109	0	141	0	173	0	205	0	237	0
14	0	46	123	78	0	110	0	142	0	174	0	206	0	238	0
15	0	47	209	79	0	111	0	143	0	175	0	207	0	239	0
	0	48	471	80	0	112	0	144	0	176	0	208	0	240	0
17	0	49	1122	81	0	113	0	145	0	177	0	209	0	241	0
18	0	50	1922	82	0	114	0	146	0	178	0	210	0	242	0
19	0	51	1851	83	0	115	0	147	0	179	0	211	0	243	0
20	0	52	858	84	0	116	0	148	0	180	0	212	0	244	0
21	0	53	145	85	0	117	0	149	0	181	0	213	0	245	0
22	0	54	35	86	0	118	0	150	0	182	0	214	0	246	0
23	0	55	7	87	0	119	0	151	0	183	0	215	0	247	0
24	0	56	5	88	0	120	0	152	0	184	0	216	0	248	0
25	0	57	4	89	0	121	0	153	0	185	0	217	0	249	0
26	0	58	5	90	0	122	0	154	0	186	0	218	0	250	0
27	0	59	2	91	0	123	0	155	0	187	0	219	0	251	0
28	0	60	0	92	0	124	0	156	0	188	0	220	0	252	0
29	0	61	2	93	0	125	0	157	0	189	0	221	0	253	0
30	0	62	0	94	0	126	0	158	0	190	0	222	0	254	0
31	0	63	1	95	0	127	0	159	0	191	0	223	0	255	0

From the mean intensity value, the surface temperature is 12.08 °C

APPENDIX G5

Sample Output from the PCIPS Program for Farmington Bay, October 25, 1978

Mean	45.57
Std. Dev.	3.65
Entropy	3.61
Minimum	39
Maximum	61
No. Pixels	1,956

Zero intensity pixels not counted

Histogram ----------

Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count	Int	Count
0	0	32	0	64	0	96	0	128	0	160	0	192	0	224	0
[illegible]	0	33	0	65	0	97	0	129	0	161	0	193	0	225	0
2	0	34	0	66	0	98	0	130	0	162	0	194	0	226	0
3	0	35	0	67	0	99	0	131	0	163	0	195	0	227	0
4	0	36	0	68	0	100	0	132	0	164	0	196	0	228	0
5	0	37	0	69	0	101	0	133	0	165	0	197	0	229	0
6	0	38	0	70	0	102	0	134	0	166	0	198	0	230	0
7	0	39	1	71	0	103	0	135	0	167	0	199	0	231	0
8	0	40	9	72	0	104	0	136	0	168	0	200	0	232	0
9	0	41	81	73	0	105	0	137	0	169	0	201	0	233	0
10	0	42	231	74	0	106	0	138	0	170	0	202	0	234	0
11	0	43	367	75	0	107	0	139	0	171	0	203	0	235	0
12	0	44	328	76	0	108	0	140	0	172	0	204	0	236	0
13	0	45	193	77	0	109	0	141	0	173	0	205	0	237	0
14	0	46	129	78	0	110	0	142	0	174	0	206	0	238	0
15	0	47	123	79	0	111	0	143	0	175	0	207	0	239	0
[illegible]	0	48	116	80	0	112	0	144	0	176	0	208	0	240	0
17	0	49	104	81	0	113	0	145	0	177	0	209	0	241	0
18	0	50	60	82	0	114	0	146	0	178	0	210	0	242	0
19	0	51	52	83	0	115	0	147	0	179	0	211	0	243	0
20	0	52	45	84	0	116	0	148	0	180	0	212	0	244	0
21	0	53	26	85	0	117	0	149	0	181	0	213	0	245	0
22	0	54	28	86	0	118	0	150	0	182	0	214	0	246	0
23	0	55	20	87	0	119	0	151	0	183	0	215	0	247	0
24	0	56	22	88	0	120	0	152	0	184	0	216	0	248	0
25	0	57	7	89	0	121	0	153	0	185	0	217	0	249	0
26	0	58	6	90	0	122	0	154	0	186	0	218	0	250	0
27	0	59	4	91	0	123	0	155	0	187	0	219	0	251	0
28	0	60	2	92	0	124	0	156	0	188	0	220	0	252	0
29	0	61	2	93	0	125	0	157	0	189	0	221	0	253	0
30	0	62	0	94	0	126	0	158	0	190	0	222	0	254	0
31	0	63	0	95	0	127	0	159	0	191	0	223	0	255	0

From the mean intensity value, the surface temperature is 10.4 °C.

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